DIGITAL DEAD ENDS ALONG ALASKA'S INFORMATION HIGHWAY: BROADBAND ACCESS FOR STUDENTS AND TEACHERS IN ALASKA'S HIGH SCHOOL ONE-TO-ONE LAPTOP PROGRAMS

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A

DISSERTATION

Presented to the Faculty
of the University of Alaska Fairbanks

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By

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Abstract

This dissertation analyzes the potential impact community broadband availability has on personal and classroom levels of technology adoption for high school students and teachers in Alaska. Community broadband availability was defined as, (a) terrestrial broadband availability; (b) satellite broadband availability; and (c) no broadband available.

The theoretical framework for this study used a concurrent mixed methods design, beginning with quantitative surveys with open-ended questions administered to teachers and students. Open coding analysis produced themes from student focus groups and open-ended questions used to complement the quantitative analysis. The sample population included high school teachers and students in one-to-one laptop programs from 13 school districts in 39 communities in Alaska spread across three categories of community broadband availability. All participating schools met the criteria for a complete one-to-one laptop solution.

Key findings using an analysis of variance resulted in a statistically significant difference in personal use levels of adoption among students compared across three categories of community broadband available. Students living in communities with no broadband access had lower personal use levels of adoption compared to students living in communities with terrestrial or satellite broadband availability. There was no significant difference in student classroom levels technology adoption compared across three categories of community broadband availability. There was no statistical difference among teachers in personal or classroom levels of adoption.

There continues to be a need to study these digital learning environments to determine conditions under which positive learning outcomes may be achieved. A study based in Alaska, focusing on student and teacher levels of adoption in personal and classroom, given broadband availability will provide data for policymakers, administrators, and stakeholders to make decisions regarding the impacts of the digital divide. The investment in rural areas of Alaska is significant for not only jobs and long-

term economic benefits, but also to the citizenry of Alaska in expanding the opportunities for all of our students to be globally competitive, no matter their zip code.

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Biographical Sketch

Pamela Jo Lloyd was born on May 21, 1961 in Charleston, South Carolina to Robert and Marjean Brody. Growing up as a military dependent, allowed her the privilege to live across the globe, attending pre-school and kindergarten in Germany, and elementary school in Wisconsin, Florida, Virginia, and Texas. In 1974, she moved to North Pole, Alaska, and has since called Alaska home.

Her late mother, Marjean taught in the Fairbanks North Star Borough School District for almost twenty years, and her late brother, Mark received his law degree from Lewis and Clark, but was never able to practice due to health issues. Her father, Robert retired from the Air Force after 22 years of service. He then, began his second career as the director for the University of La Verne where he taught finance and business courses before retiring in 2007.

After graduating from Ben Eielson High School in 1979, Pamela worked for an accounting firm automating financial records for various companies in Fairbanks, using a computer timeshare software application. She also attended the University of Alaska Fairbanks part-time. While attending the University of Alaska part-time, she continued to work in Fairbanks at Doyon Construction and Enserch/AIC until 1983.

In February 1984, Pamela married Richard Lloyd, and moved to Oklahoma. She continued her education at Rogers State College. While attending school part-time, she also worked for Blue Cross and Blue Shield of Oklahoma in the information networking division where she created training plans on computer applications. In 1987, Richard and Pamela were blessed with a son, Eric Matthew Lloyd. At five weeks old, Eric, with his parents, began the journey back to Pamela's home in Fairbanks, Alaska.

In 1988, Pamela returned to school, attending the University of Alaska-Anchorage (UAA) full-time, to pursue a degree in Elementary Education. In the fall of 1988, Richard and Pamela were blessed with a second child, Amber Nicole Lloyd, yet Pamela continued her studies at UAA and graduated in May 1991.

Pamela began her teaching career with the Anchorage School District in August 1991 as an elementary teacher at College Gate, and then relocated to Klatt, and later

Kincaid Elementary schools. In 1998, she changed career paths and became the technology coordinator at Mears Middle School. She left Mears to take a position as Technology Teacher Expert in the administration office in 2000, which led to a position overseeing all of Instructional Technology as the K-12 Technology Coordinator in 2001. In 2002, she completed her Education Technology endorsement with the University of Alaska-Southeast, and began the work to complete her Masters Degree in Education Leadership from UAA. She left the K-12 Technology Coordinator position in 2006 to pursue a career in the private sector, overseeing the K-12 division within General Communications, Inc. (GCI) where she is currently the Director of GCI SchoolAccess, a vertical division within GCI that focuses on K-12 telecommunications services and products, with a focus on rural education in Alaska, Montana, and New Mexico.

In 2009, Pamela completed her Masters in Education Leadership, and that fall enrolled in courses at the University of Alaska Fairbanks (UAF) to fulfill the requirements for an interdisciplinary Ph.D. Pamela is a leader in the state in the area of distance learning, online learning, and education technology. She continues in her position with GCI, where she is able to combine her passion for education and her technology skills to provide the best services available to students and teachers across Alaska and the lower 48.

Dedication

This dissertation is dedicated to my mother, Marjean Mae Brody, for without her continued guidance and voice, I would not be the person I am today. She was and continues to be the strength and courage that I pull from in all that I am able to accomplish in life.

To my husband, Rick, who has always been there for me, believed in my ability to reach for the stars and always supported me when I needed support the most.

To my father, who continued to share his pride and excitement in the next chapter and journey in life, pushing me to accomplish great things through patience and perseverance.

To my children, Eric and Amber, who have been my biggest teachers in life, for without them, I would not know the joy of being a parent, a friend, and a mentor.

Acknowledgements

A special thanks to my cohort members, Bob, Larry, and Mark, for without their continued guidance, questioning, and support, I would not have been able to complete this chapter in my life. Their continued presence, phone calls, emails, and questioning provided the needed push to accomplish this great feat.

I am also grateful and thankful to Dr. John Monahan, my chair, for having the vision and the drive to continue to support the Ph.D cohort model at the University of Alaska, Fairbanks.

Thank you John for believing that our cohort could accomplish greatness. And, a special thank you to Jane Monahan for keeping us all in line and making sure our paperwork was in order.

A heartfelt thanks to Dr. Barbara Adams who stuck with me through it all, gave up three years of her life to meet with me regularly, and questioned my methods and methodology that taught me so much about the art of becoming a researcher.

A special thank you to my friend and colleague, Monica Cougan, who was my critical friend in this process, spending many hours reading through my drafts, asking questions, and pushing me to the next level of writing. And to Nina Kominiak who spent many weekends with me assisting me with statistical analyses.

I also want to thank my committee members, Dr. Robert Crumley, Dr. Norm Eck, Dr. Phil Knight, Dr. Jean Richey, and Dr. Roy Roehl for their support, guidance, and leadership, which was thoughtful and timely during all phases of the dissertation process.

Finally, to all of the teachers, students and leaders in the school districts in Alaska, a special thank-you. I owe you a debt of gratitude for the work you do each and every day to make a difference in our young peoples' lives. Without your support and dedication to the education profession, we would not have been able to conduct this research.

Chapter 1: Introduction

Laptop programs where each student has a laptop computer commonly referred to as one-to-one, have swept not only the nation, but are being implemented around the world. Over the years, K-12 education has brought forward four specific goals for one-to-one laptop programs. The first and primary goal for most school districts has been to increase academic achievement (Apple Computer Inc., 2005; Bonifaz & Zucker, 2004; Culp, Honey, & Mandinach, 2003; Lemke & Martin, 2003; Metiri Group, 2006; Penuel, 2006; 2002; Silvernail & Lane, 2004). Secondly, programs have focused on the goal to increase equity in the access to digital instructional resources to reduce the digital divide (Warschauer, 2003b). Thirdly, one of the largest implementations in the state of Maine focused on increasing economic competitiveness by preparing its students with 21st century skills for the workforce (Silvernail & Lane, 2004). Lastly, some initiatives for one-to-one laptops sought to transform the quality of instruction in the classroom to create a more student-centered classroom.

While one-to-one laptops or ubiquitous computing are relatively new to the interventions for students and teachers used to reform K-12 education, technology used for instruction in the K-12 classroom, began over 20 years ago when the Nation at Risk report identified technology as one of the five "new basics" to reform education. These reforms required the inclusion of computer science in all high school graduation requirements (National Commission on Excellence in Education, 1983). Since this report, printed in 1983, American schools have continued to build on technology capacity, with over $40 billion dollars spent on technology infrastructure (Dickard, 2003). In 2001, the emphasis for students to have technology literacy skills to communicate, to locate and manage information, and to use these tools effectively to support learning was evidenced by legislation in the No Child Left Behind Act of 2001 (Elementary and Secondary Education Act, 2001). It logically proceeds that policymakers and stakeholders want to ensure quality in the use of education technology in K-12 settings to provide results with positive outcomes for the goals identified above. Furthermore, policymakers and administrators continually need to rationalize the investment and the sustainability for education. To that extent, the past twenty years have offered practitioners and policymakers a plethora of research. Many of the aforementioned reports have rationalized the investment on four key themes that communicate the urgency for creating technology rich learning environments in K-12 classrooms. These themes include, (a) the use of technology for addressing challenges in teaching and learning, specifically addressing the need to provide instruction to a geographically dispersed audience; (b) the use of technology to be used as a change agent to provide a more constructivist style of teaching; the use of digital content to change the learning environment; and the idea that technology is important in education as it is a central force in economic competiveness, providing students with critical technology skills for future employment (Culp et al., 2003). Reports, such as Learning for the 21st Century, only make this case stronger in reviewing the impact that technology has on the global marketplace (Partnership for 21st Century Skills, 2010).

The inception of one-to-one laptop programs in Alaska was derived from these same themes and as such, has adopted similar goals. Alaska's high schools embarked on the journey to bring the 21st century skills to students' knowledge foundation as part of a statewide project funded in part by the Alaska 24th and 25th Legislature through the Association of Alaska School Boards (Ohler, 2011). The Association of Alaska School Boards (AASB) formed the Consortium for Digital Learning (CDL) with the main purpose to focus on a one-to-one laptop initiative to investigate the potential of these devices to, (a) increase students' 21st century skills; (b) improve student achievement; and (c) prepare students for success in the global economy.

In 2006, the AASB-CDL received $5 million in capital funds from the Alaska 24th Legislature. This fund allowed the AASB-CDL to provide one-to-one laptop programs in 18 school districts. The AASB-CDL initiative was formed to work with schools in Alaska to create a digital learning environment where each student was provided with a laptop with wireless capability to, (a) enable communication and collaboration among peers and teachers; (b) extend the learning day; and (c) more closely connect parents to the educational process (Association of Alaska School Boards, 2006).

In 2008, AASB received an additional $2.5M from Alaska's 25th Legislature. According to Ohler (2011), AASB had over 100 one-to-one laptop school projects. To-date, there has been little research on the implementation of one-to-one laptop implementations in Alaska.

In 2009, a cohort of four members, sought to study these one-to-one laptop implementations through four distinct lenses. A description of the cohort model can be found in Appendix A.

1.1 Theoretical Framework

This study will focus on the barriers for learning that include the lack of digital instructional resources that may be prevalent when broadband is not available in the home. The theoretical framework for this study used a concurrent mixed methods approach, beginning with a quantitative broad survey with open-ended questions and secondly, qualitative narrative from student focus groups in four schools. The data from the qualitative open-ended questions, as well as the focus groups in four of the districts, were used to complement the quantitative data (Johnson & Onwuegbuzie, 2004). This study compares Levels of Adoption (LoA) in classroom and personal use, given three categories of community broadband availability for teacher and student groups.

This study examines the impact of digital exclusion, and potential lost opportunities for learning beyond the school day for those students participating in one-to-one laptop programs in Alaska when they live in areas of the state that do not have community broadband access available in the home. Community broadband access availability is defined by the internet service packages provided by local providers as shown in Appendix B.

According to H. J. Becker (1999), the lack of broadband access may also strengthen teacher perceptions of their students, regarding student access beyond the school day. These perceptions may hinder the creation of online instructional resources such as web sites, online tutorials or homework help for learning beyond the school day if teachers perceive a lack of broadband access for their students. These perceptions and beliefs about student access create a further divide to extending the learning day with rich learning resources.

1.2 Overview of Methodology

Research design requires a rigorous foundation in creating criteria, collection of data, transcribing the data, analysis of the data, and conclusions of the data (Blessing, Chakrabarti, & Wallace, 1998). The research design for this study used a descriptive comparative inquiry that reviewed the implementation of one-to-one laptop programs in high schools in Alaska communities, which had the specific goal for the laptop program to extend the learning day for students. The research for this study focused on high schools in Alaska that implemented a one-to-one laptop program and had a common defined implementation that included, (a) anytime, anywhere access in and out of school for both teachers and students; (b) wireless infrastructure capable for one-to-one laptops in classrooms and schools; (c) laptops which had necessary software tied to curriculum goals for student learning; and (d) a required number of hours for professional development for using laptops as learning tools (Association of Alaska School Boards, 2006).

This study examined the impact of digital exclusion and potential lost opportunities when lack of broadband access creates inequity for learning beyond the school day. The cohort members collectively created surveys for teachers and students and these were comprised of a 215-item teacher questionnaire, and a 100-item student questionnaire. Both surveys were administered to high school teachers and students in 39 communities across Alaska. In addition, each cohort member contributed a question specific to his/her research as part of the focus groups led by a fourth cohort member (Standley, 2012). The quantitative surveys were developed by the cohort using modified versions of existing surveys used in two previous studies (Dalgarno, 2009; Lemke, 2009). The quantitative survey approach provided a research model to compare self-reported levels of technology adoption, as defined through proficiency and frequency of use by teachers and students across a sample population.

Both the teacher and student surveys used a multi-stage sampling procedure with both likert-scale items and open-ended questions. Twenty-one schools were identified in the program population as having one-to-one laptop programs, with thirteen school districts meeting the defined criteria as described in section 3.4.1.

1.3 Statement of the Problem

Over the past ten years, researchers across the nation have focused on the implementation of one-to-one learning environments in schools and the conditions under which positive learning outcomes may be achieved (Van Hover, Berson, Bolick, & Swan, 2006). In addition to the positive conditions, there has also been much research around the barriers to implementation of one-to-one laptop programs in K-12 settings. The use of laptops and internet connectivity in education, specifically in rural areas has provided opportunities for learning 21st century skills would not have been possible otherwise (Bebell & Kay, 2010).

While much of the research studies in education show that one-to-one laptop programs have improved student achievement (Bebell & Kay, 2010; Lowther, Morrison, & Ross, 2003; Silvernail & Buffington, 2009; Zucker, 2004), most of them fail to address the barriers that affect these outcomes (H. J. Becker, 2000a). The barriers identified by Hew and Brush (2006), include: (a) resources; (b) institution; (c) subject culture; (d) attitudes and beliefs; (e) knowledge and skills; and (f) assessment, and all play a significant role in the success of one-to-one laptop programs. Specifically, the lack of resources is a substantial barrier for communities in rural Alaska where broadband availability beyond the school day is not available. A portion of the AASB-CDL implementation model required that schools provided wireless infrastructure within the school walls, however, the missing component of internet access capacity from the school to the web, coupled with the lack of broadband capacity for homes, became barriers for students and teachers in rural Alaska.

School districts in Alaska, like other schools in America receive a subsidy for telecommunications and Internet access through the Universal Service Fund (USF) administered by the Universal Services Administrative Company (USAC) under the direction of the Federal Communications Commission (FCC). The Universal Service Fund totals about $2.25 billion per year and provides subsidy to support the Schools and Libraries Program, commonly referred to as E-rate. For many of the school districts in Alaska, this fund provides discounts to assist schools and libraries in obtaining affordable telecommunications and Internet access. Discounts for support depend on the level of poverty and the urban/rural status of the population served and range from 20% to 90% of the costs of eligible services. Most rural school districts in Alaska receive between 70% and 90% discounts (Universal Services Administrative Company, 2011).

Broadband in the school has implications for classroom use levels of adoption. Understanding the funding source and how this impacts one-to-one laptop programs is critical to the success of the program to provide resources for teaching and learning. Because school districts must plan a year in advance for bandwidth requirements, due to program application rules, many districts that first implemented the one-to-one laptop programs in their schools did not have adequate bandwidth to support these additional devices. School districts in rural Alaska would not be able to afford the high cost of bandwidth if it were not for this discount program. Unfortunately, there is not a program for internet access in the home, leaving many areas in rural Alaska as un-served or under-served for broadband capacity.

As Americans become accustomed to using the internet in daily life, the increase in broadband access across the nation has seen a steady growth. In the last decade, the percent of U.S. households owning a computer and using broadband Internet has risen steadily as identified by the National Telecommunications and Information Administration (NTIA, 2010) as shown in Figure 1.

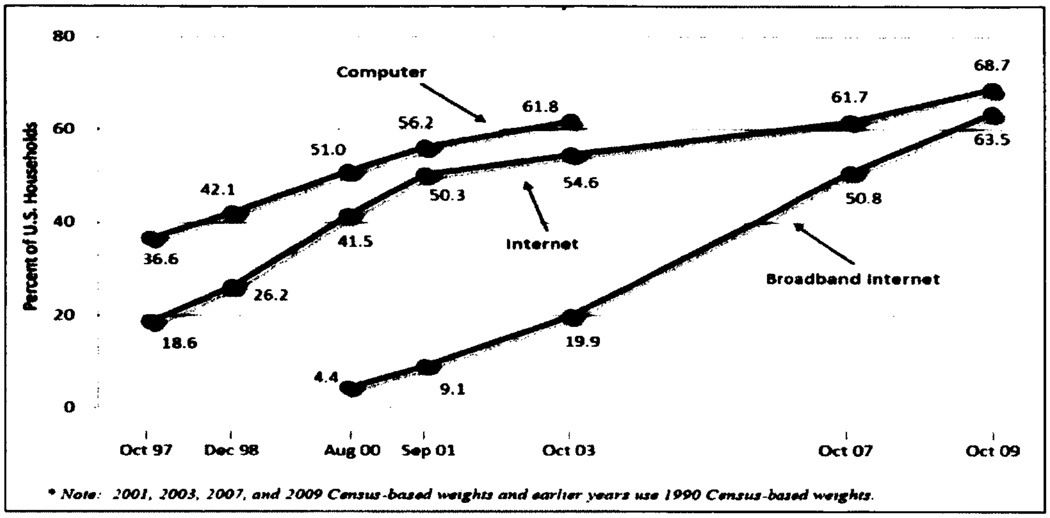


Figure 1. NTIA percent of U.S. households using broadband internet.

As the FCC's National Broadband Plan states, "broadband is a foundation for economic growth, job creation, global competiveness, and a better way of life" (FCC, 2011, p. xi). Approximately 100 million Americans do not have broadband in their homes (Federal Communication Commission, 2010). The need for broadband is profound in communities in rural Alaska as identified by the available consumer internet services available for home/consumer use found in Appendix B.

Broadband, as defined by the FCC, (2010) is a speed of 786 Kbps download speed and 200 Kbps upload speed. Broadband is not equitably distributed across Alaska communities and as such creates a digital divide for students and teachers in their use of laptops beyond the school day to extend learning. The barriers are many, and include expense, availability, and population. The expense of satellite for middle mile transport delivery, the segment of a telecommunications network linking the core network to the local community network, and the small populations in many of these communities does not provide a business case for Internet providers to deliver broadband. Without broadband access, students may not have the same opportunities to extend their learning day and increase academic achievement (M. G. Robinson, 2007; Vigdor & Ladd, 2010; Warschauer, 2003a).

Technology has a great potential for improving education through increased student motivation, engagement and time on task (Bebell & Kay, 2010; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010; Silvernail & Lane, 2004). The capacity for laptops to be used in the home environment can and will create new forms of parent involvement through online communication of achievement, homework assistance and assignments (Penuel et al., 2002). The National Center for Education Statistics (NCES) shared that the most popular use of internet by teens was to complete school assignments (National Center for Education Statistics, 2004). In 2010, the Generations Online summary report showed that searching for current information and news was still the top rated online activity by 90-100% of the teenage survey participants, with social networking a close second (Zickuher, 2010).

The topic of equity and digital divide has been a focus for technology and access availability in the home for decades (Dickes, Lamie, & Whitacre, 2011; M. G. Robinson, 2007; Vigdor & Ladd, 2010; Warschauer, 2003a). While the one-to-one laptop programs in Alaska's schools removed the barrier of technology by providing a laptop for students and teachers for school and home use, it did not address the inequity in broadband access. If the belief that access to computer technology and internet resources improves educational effectiveness, then it is important that this technology and access be equitably distributed among schools in rich and poor areas, no matter where they live (Kulik, 2003). "It is clearly inequitable for poor and minority children to have less access to a valuable resource than other children do" (Kulik, 2003, p. 57). The same can be said for the inequity for students living in communities in Alaska that do not have access to broadband in the home.

1.4 Backdrop to the Study

1.4.1 One-to-one laptop initiative in Alaska.

In the past decade, school districts and education partners in Alaska have worked tirelessly to provide tools and access to 21st century learning, providing access to content and learning materials to bridge the digital divide. In 2006, the AASB-CDL answered the call by securing legislative funding to provide a grant/match program made available to all Alaska school districts. The CDL initiative was awarded $5 million in capital funds by the Alaska 24th Legislature in 2006 and in 2008, the 25th Alaska Legislature added another $2.5 million. All AASB-CDL projects are shown in Figure 2.

Figure 2. AASB-CDL 2007-2010 projects in Alaska.

School District	# of Schools	Total Users	Grades	USED in STUDY POPUlATION	USED IN STUDY SAMPLE	Year Implemented	Met Definition
Alaska Gateway	1	56	6-8	NO	NO	2006	N
Anchorage	1	135	7	NO	NO	2006	N
Anchorage	8	6135	6,7,8,9	NO	NO	2008	N
Bristol Bay Borough	1	36	9-12	YES	YES	2006	Y
Copper River	3	52	9	NO	NO	2008	N
Cordova	1	127	7-9	YES	YES	2006	Y
Craig	3	187	6-12	YES	NO	2006	P
Denali	3	173	6-10	YES	NO	2006	Y
Denali		40		YES	NO	2008	Y
Dillingham	1	81	7-8	NO	NO	2006	N
Fairbanks	1	96	6	NO	NO	2006	N
Iditarod	4	73	8-12	YES	NO	2008	Y
Juneau	1	150	9-12	NO	NO	2006	N
Juneau	2	455	9	YES	YES	2008	P
Kashunamiut	1	111	9-12	YES	NO	2008	Y
Kenai	2	73	9, 9-12	NO	NO	2008	N
Ketchikan	1	172	7	NO	NO	2008	N
Klawock	1	61	9-12	YES	YES	2006	Y
Kodiak	1	100	2-5	NO	NO	2006	N
Kuspuk	7	150	9-12	YES	YES	2006	Y
Lake and Penn	2	30	9-12	YES	NO	2006	Y
LKSD	8	234	8-10	YES	YES	2006	P
LKSD	4	146	9-12	YES	YES	2008	Y
North Slope	11	1756	1-12	YES	YES	2006	P
NWABSD	3	112	9-12	YES	YES	2008	Y
Petersburg	3	347	3-12	YES	YES	2006	P
Pribilof	2	33	9-12	YES	NO	2008	Y
SEISD	8	125	6-12	YES	NO	2006	P
SWRSD	4	217	6-12	YES	YES	2006	P
Valdez	1	113	7-8	NO	NO	2008	N
Wrangell	1	153	9-12	YES	YES	2008	Y
Yukon Flats	1	68	6-12	YES	NO	2006	P
Subtotal	91	11797					

http://web.mac.com/aasb.cdl/Consortium for Digital Learning/About AASB-CDL.html

By 2011, the one-to-one laptop initiative has been implemented in 28 of 53 school districts in various grade levels across Alaska (Ohler, 2011). This digital learning environment provided each student and teacher with a laptop, including wireless capability with the goals for "enabling communication and collaboration among peers and teachers, extending the learning day, and more closely connecting parents to the educational process" (Ohler, 2011, p. 10).

1.4.2 The National Broadband Plan.

At the same time the demand for technology to close the digital divide was being realized; the need for broadband was realized and addressed by our nation. At the end of the first decade of the 21st century, the movement to push the U.S. to be globally competitive became the impetus to shift the focus on the infrastructure for broadband for every American.

In 2009, Congress provided direction to the FCC to develop and deliver a National Broadband Plan to ensure that every American had access to broadband in the home. The plan identified the power of transformation for broadband to change the lives of the American people through a complex ecosystem that included applications, network devices and the network that carries the applications to the devices as shown in Figure 3 (Federal Communication Commission, 2010).

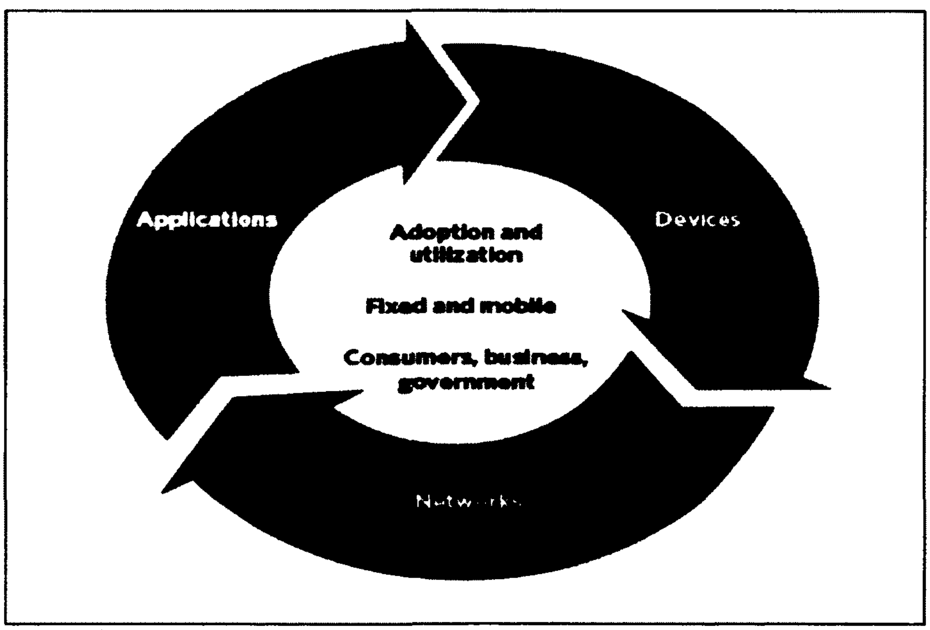


Figure 3. FCC adoption of broadband ecosystem.

These forces shaping the broadband ecosystem in the United States as identified in the FCC National Broadband Plan show the balance between devices, applications, and network in order for adoption and utilization to be realized. The adoption and use is largely driven by the applications that are used with the devices on the network. The network, devices, and applications are all integral pieces of the broadband ecosystem. For homes that do not have broadband access, the ecosystem becomes unbalanced, causing the consumer to have more limited access to the applications available, which lowers the adoption of use.

The issues for broadband adoption and the need for the people and businesses to interact and adopt these applications through devices rely heavily on the value and affordability of the access to the network. The external forces of the network, devices and applications coupled with the demand for broadband utilization continues to drive the explosive growth in expanding the need and demand for the transformation of the ecosystem.

1.4.3 Broadband applications.

Students and teachers across the nation are turning to content that uses high bandwidth access, such as video and multi-media, as identified in the FCC National Broadband Plan. Many of these applications are delivered via a service over the internet, rather than a product. This kind of service is known as cloud computing. Cloud computing allows for files and applications to be delivered from a centralized server, allowing for the end user to have flexibility for access with multiple devices and offers easy sharing of files, creating a more collaborative environment. Today, many applications and education resources are available only through cloud computing. It is rare today that one can purchase an application or a software program and expect it to be shipped in a CD media format contained in a shrink-wrapped box.

The digital divide for our students and teachers in Alaska is no longer access to the computer or device: it is access to the high-speed network. Networks in rural Alaska have not grown in capacity to handle the forces within the transforming bandwidth ecosystem for applications, mostly due to the high-cost of delivery in satellite used for the middle-mile transport delivery.

The FCC National Broadband Plan identified the actual download speeds, measured in megabytes per second (mbps) necessary to run concurrent applications as soon in Figure 4 (Federal Communication Commission, 2010).

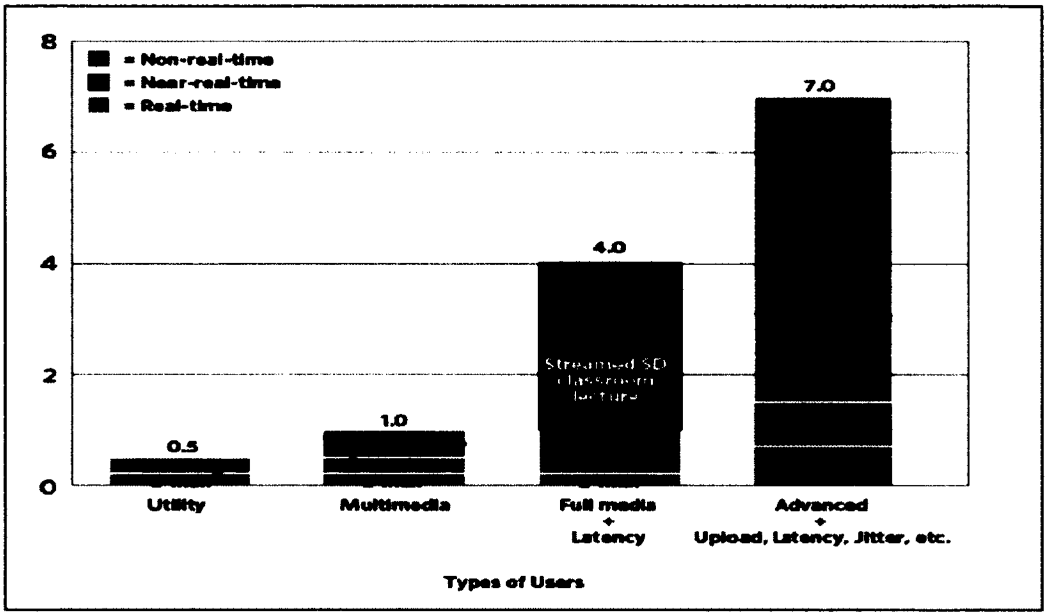


Figure 4. FCC actual download speeds necessary for applications.

The growth of video for both video conferencing applications like Skype and content platforms such as YouTube are dominating the internet to create more demand for broadband. The changing forces of applications coupled with cloud computing and the growth in the number of devices a person uses on the network is creating an imbalance in the broadband ecosystem for rural Alaska.

Communities without broadband access for students and teachers do not provide the same level of access for applications compared to communities where broadband access is available. The FCC National Broadband Plan (2010) has set a target date of 2020 for every household in America to have actual download speeds of at least 4 Mbps and actual upload speeds of at least 1 Mbps, sixteen times what is available to most of rural Alaska villages today (Appendix B).

For all rural schools in Alaska, online learning and courses supported through broadband access can supplement education through the creation of a blended environment for instructional activities to support students in the classroom (Holcomb, Castek, & Johnson, 2007). Many students and teachers live in communities where broadband access is not available (Appendix B). Students without access to broadband have difficulty accessing resources and/or services, as it is impractical due to slower connections. Students do not have the ability to take additional coursework beyond the school day or use free resources available to Alaskans through the Statewide Library Electronic Doorway (SLED). SLED provides live homework help, a digital pipeline for primary sources, and research databases free of charge to all Alaska residents. Primary resources provided by services like SLED coupled with resources to create differentiated online curriculum materials like flexible textbooks (flexbooks), provide teachers with resources to create adaptive learning environments to differentiate instruction for students. According to H. J. Becker, (1999) if teachers perceive students to not have broadband access, they may not create online learning environments for their students to extend the learning day.

1.5 Significance of the Study

It is important that policy makers, government officials, school administrators, teachers, and researchers understand the issues of digital inequities that may present barriers in one-to-one laptop programs meant to reform education. These inequities provide barriers to resources and online learning environments, and further the digital divide for students in rural Alaska.

A study based in Alaska, focusing on comparing levels of technology adoption for teachers and students, who are part of a one-to-one laptop program across varied community broadband availability, will highlight the digital divide for our un-served and underserved populations. Broadband in the homes of students and teachers can bring equity in the use of learning resources to all students and teachers no matter their zip code. The results of this study will add to the research base and knowledge in future implementations of one-to-one laptop programs. Schools across Alaska have invested in the premise that technology through one-to-one laptop programs will make a difference for teaching and learning. Research conducted on Alaska's one-to-one laptop programs has been sparse. Three studies, to-date, have analyzed the impact of the AASB-CDL project (Edwin, Hirshberg, & Hill, 2009; Ohler, 2009, 2011). Each of the three studies focused on the implementation and goals of the project using both qualitative and quantitative methods. This study will provide relevant data to complement the research to-date by providing a detailed picture of broadband access and the impact it has on levels of adoption in classroom and personal use.

Four broad areas within the literature are relevant to this study. The first area is the impact and role that broadband plays in creating conditions for sustainable economic growth and prosperity. The second area focuses on the implementation of one-to-one laptops across the nation with an emphasis on academic achievement in reference to home access and learning environments. The third area focuses on teacher and student perceptions and concerns in implementations of one-to-one laptop programs. And lastly, the fourth area focuses on digital equity and the barriers for implementing one-to-one laptop programs.

1.6 Research Questions

One broad research question with nine investigative questions provides the foundation for this study: "Does the broadband availability in a school community have an impact on the teaching and learning experience for high school teachers and students in one-to-one laptop programs across Alaska?"

1.6.1 Student perceptions and use.

The following research questions provide clarity of students' perception and use, given three categories of community broadband availability.

Research Question 1: Does access to broadband in the home make a difference in the amount of time spent by students using the laptop for home use?

Research Question 2: Does access to broadband in the home make a difference in the amount of time spent by students on laptop for schoolwork?

Research Question 3: Does access to broadband in the home make a difference in Student Personal Use (SPU) Levels of Adoption (LoA)?

Research Question 4: Does access to broadband in the home make a difference in Student Classroom Use (SCU) LoA?

Research Question 5: Does access to broadband in the home make a difference as to whether teachers assign homework that requires Internet access at home?

1.6.2 Teacher perceptions and use.

The following research questions provide clarity and understanding of teachers' perceptions and use, given three categories of community broadband availability.

Research Question 6: Does access to broadband in the home make a difference in the amount of time spent by teachers using the laptop for home use?

Research Question 7: Does access to broadband in the home make a difference in Teacher Personal Use LoA?

Research Question 8: Does access to broadband in the home make a difference in Teacher Classroom Use LoA?

Research Question 9: Does access to broadband in the home make a difference as to whether teachers create online learning resources for students to extend the learning day requiring internet access at home?

1.7 Description of the Communities

The 39 school communities that make up the study population are spread across Alaska. The description of these 39 communities was created using the Alaska Community Database for Community Information. Thirteen school districts make up the 39 communities and include: (a) Aleutians East Borough; (b) Bristol Bay Borough; (c) Cordova; (d) Haines; (e) Juneau; (f) Klawock; (g) Kuspuk; (h) Lower Kuskokwim; (i) North Slope Borough; (j) Northwest Arctic Borough; (k) Petersburg; (l) Southwest Region; and (m) Wrangell. One-to-one high school communities surveyed is shown in Figure 5 (Whicker, 2012).

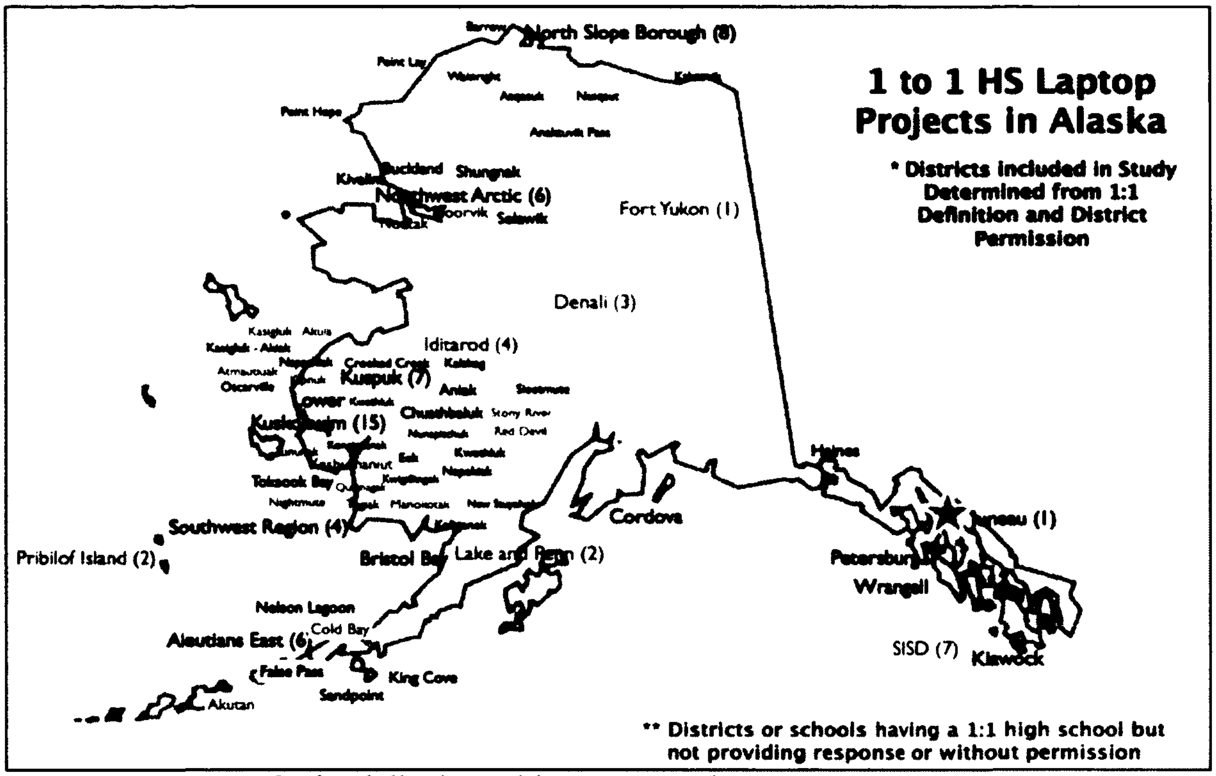


Figure 5. Map of school districts with one-to-one laptop programs.

For the purpose of this study, school communities will be defined as belonging to one of three categories of community broadband availability to include, (a) communities with broadband delivered via terrestrial middle-mile; (b) communities with broadband delivered via satellite middle-mile; and (c) communities with no broadband access using the FCC (2010) definition for broadband as 786 Kbps download speed/200 Kbps upload speed. These communities make up the digital landscape for Alaska's high school teachers and students who are participating in the one-to-one laptop program.

Internet access beyond the school day in the 39 communities was captured using local and statewide telecommunications providers' information with internet services available in each of the communities in the study as shown in Appendix B. In addition, information on middle mile delivery for internet services was obtained through a report shared by the Alaska Broadband Task Force. Follow up emails were sent to school district officials to validate information where there was little or no information on the provider's website.

Three categories of community broadband availability, including, (a) broadband access via terrestrial middle mile; (b) broadband access via satellite middle mile; and (c) no broadband access, were identified as a variable for students and teachers in both surveys to categorize the availability of community broadband access available. Community broadband availability was defined as broadband available in the community that could be purchased from a local exchange carrier or other telecommunications carrier where the facilities were located in that community. Service delivery through personally owned satellite dish services like HughesNet or Starband were not included as a viable service delivery for these communities as they relied solely on the ability of the end-user to install and maintain the equipment.

A distribution of frequencies for student and teacher sample in the three community broadband availability categories show the highest percent (48.4%) of teachers (n=94), and the highest percent (52.7%) of students (n=725) represented in communities where broadband is not available as shown in Table 1.

Table 1

Broadband Access Service Levels for Students and Teachers

Community	Teachers		Students	
	Frequency	Percent	Frequency	Percent
Terrestrial Broadband	27	29.5%	243	33.5 %
Satellite Broadband	21	22.1%	100	13.8%
Broadband not Available	46	48.4%	382	52.7%
Total N	94	100.0%	725	100.0%

1.7.1 Communities with terrestrial broadband availability.

These communities have broadband available through fiber and/or microwave terrestrial middle mile transport that connects the local internet provider to the network core. The participants in these school communities have availability of broadband speeds that are less expensive than those that have broadband services available via satellite middle mile transport.

These school communities include, (a) Haines; (b) Juneau; (c) Klawock; (d) Petersburg; and (e) Wrangell. There were 243 or 33.5% of the student participants and 27 or 29.5% of the teacher participants in this category of broadband delivery.

1.7.1.1 Haines, Alaska

The community of Haines, where the students of Haines School District live is located on the shores of the Lynn Canal between the Chilkoot and Chilkat Rivers, approximately 80 air miles northwest of Juneau. The school district had an enrollment of 304 students with a certificated staff of 28, made Adequate Yearly Progress (AYP) in the 2010-2011 school year, and is not a Title 1 school or low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). While the school district was not part of the AASB-CDL laptop program, they have furnished students and teachers with laptops and participated in the professional development offered by AASB-CDL. According to the 2010 Census, the community population of 2,508 is approximately 9.2 percent American Indian or Alaska Native, 83.2 percent White, 0.4 percent Black, 0.6 percent Asian, 1.9 percent Hispanic, and 7.8 percent identified themselves as multi-racial (U.S. Census Bureau, 2011). The community of Haines receives internet in the home via terrestrial microwave middle mile.

1.7.1.2 Juneau, Alaska

The community of Juneau, where the students of Thunder Mountain School live is located on the mainland of Southeast Alaska, at the heart of the inside passage along the Gastineau Channel. The community encompasses approximately 2716 square miles of land and 538 square miles of water. The school had an enrollment of 643 students with a certificated staff of 41, did not make Adequate Yearly Progress (AYP) in the 2010-2011 school year, and is not a Title 1 school or low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched approximately 400 laptops for grade 9 in 2006. According to the 2010 Census, the community population of 31.275 is approximately 11.8 percent American Indian or Alaska Native, 69.8 percent White, 0.9 percent Black, 6.1 percent Asian, 0.7 percent Pacific Islander, 5.1 percent Hispanic, and

9.5 percent identified themselves as multi-racial (U.S. Census Bureau, 2011). The community of Juneau receives internet in the home via cable modem and terrestrial fiber middle mile.

1.7.1.3 Klawock, Alaska

The community of Klawock, where the students of Klawock School live is located on the west coast of Prince of Wales Island. The community encompasses approximately 0.6 square miles of land and 0.3 square miles of water. There are no roads to Klawock and the only way transportation method to get to and from Klawock is by air or by boat. The school had an enrollment of 136 students with a certificated staff of 19, making Adequate Yearly Progress (AYP) in the 2010-2011 school year. Klawock School is considered a Title 1 school or low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 61 laptops for grades 9-12 in 2006. According to the 2010 Census, the community population of 755 is approximately 48.3 percent American Indian or Alaska Native, 38.4 percent White, 0.3 percent Black, 0.5 percent Asian, 0.1 percent Pacific Islander, 2.8 percent Hispanic, and 11.8 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The community of Klawock receives internet in the home via middle mile terrestrial microwave towers served by Alaska Power and Telephone (AP&T).

1.7.1.4 Petersburg, Alaska

The community of Petersburg, where the students of Petersburg School live is located on the northwest end of Mitkof Island, where the Wrangell Narrows meet Frederick Sound. It lies midway between Juneau and Ketchikan and encompasses approximately 43.9 square miles of land and 2.2 square miles of water. The school had an enrollment of 487 students with a certificated staff of 49 and made Adequate Yearly Progress (AYP) in the 2010-2011 school year, and is not a Title 1 school or low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 357 laptops for grades 3-12 in 2006. According to the 2010 Census, the community population of 2,948 is approximately 7 percent American Indian or Alaska Native 80 percent White, 0.4 percent Black, 3.2 percent Asian, 0.2 percent Pacific Islander, 3.7 percent Hispanic, and 7.9 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The community of Petersburg receives internet in the home via cable modem and terrestrial fiber middle mile.

1.7.1.5 Wrangell, Alaska

The community of Wrangell, where the students of Wrangell School live, is located on the northwest tip of Wrangell Island, between Juneau and Ketchikan, and encompasses approximately 2,852 square miles of land and 883 square miles of water. The school had an enrollment of 344 students with a certificated staff of 25 and made Adequate Yearly Progress (AYP) in the 2010-2011 school year, and is not a Title 1 school or low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 153 laptops for grades 9-12 in 2008. According to the 2010 Census, the community population of 2,369 is approximately 16.2 percent American Indian or Alaska Native, 72.6 percent White, 0.2 percent Black, 1.4 percent Asian, 1.6 percent Hispanic, and 9.4 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The community of Wrangell receives internet in the home via cable modem and terrestrial fiber middle mile.

1.7.2 Communities with satellite broadband availability.

These schools are in communities that have broadband available through satellite middle-mile transport that connects the local internet provider to the network core. The participants in these school communities have availability of broadband speeds that are more expensive than those that have broadband services available via terrestrial fiber and/or microwave middle mile transport.

These school communities include Barrow and Cordova. There are 100 or 13.8% of the student participants and 21 or 22.1% of the teacher participants in this category of bandwidth delivery option.

1.7.2.1 Barrow, Alaska

The community of Barrow, where the students of Barrow High School live, is located in the northernmost community in the United States. It is located on the Chukchi Sea coast and about 725 air miles from Anchorage and encompasses approximately 18.4 square miles of land and 2.9 square miles of water, with no roads connecting Barrow to the road system in Alaska. The school had an enrollment of 218 students with a certificated staff of 20, did not make Adequate Yearly Progress (AYP) in the 2010-2011 school year, and is not a Title 1 school or low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 1.756 laptops for grades 5-12 in 2006. According to the 2010 Census, the community population of 4,212 is approximately 61.2 percent American Indian or Alaska Native, 16.9 percent White, 1.0 percent Black, 9.1 percent Asian, 2.4 percent Pacific Islander, 3.1 percent Hispanic, and 8.7 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The community of Barrow receives internet in the home via cable modem via satellite middle-mile connectivity.

1.7.2.2 Cordova, Alaska

The community where students from the Cordova School District live is located at the southeastern end of Prince William Sound in the Gulf of Alaska, with an area encompassing about 60 square miles of land and 14 square miles of water. There are no roads to Cordova. The school district had an enrollment of 335 students with a certificated staff of 33. The Cordova School made Adequate Yearly Progress (AYP), in the 2010-2011 school year, and is considered a Title 1 school or low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 127 laptops for grades 7-9 in 2006. According to the 2010 Census, the community population of 11,100 is approximately 8.8 percent American Indian or Alaska Native, 70.3 percent White, 0.5

percent Black, 10.9 percent Asian, 4.2 percent Hispanic, and 9 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The community of Cordova was moved to terrestrial middle mile via a terrestrial microwave middle mile project funded through the USDA Broadband Initiatives Program in August 2011. At the time of the data collection for this study however, the community of Cordova was being served via satellite middle mile.

1.7.3 Communities with no broadband availability.

These schools are in communities that do not have broadband available as defined by the FCC of a minimum of 786 Kilobytes per second (Kbps) download speeds and 200 Kbps upload speeds. These communities range in service levels from up to 256 Kbps/56 Kbps or dialup speeds and receive delivery through middle mile satellite transport. The participants in these school communities have internet available at much lower speeds with the average price for internet at $50/month as shown in Appendix B.

These school communities include, (a) Akutan, (b) False Pass, (c) King Cove, (d) Nelson Lagoon, and (e) Sand Point in the Aleutians East Borough School District; Naknek in Bristol Bay Borough School District; (a) Aniak, (b) Chuathbaluk, (c) Crooked Creek, (d) Kalskag, and (e) Sleetmute in the Kuspuk School District; (a) Kongiganak, (b) Kwethluk, (c) Napaskiak, (d) Nunapitchuk, (e) Napakiak, (f) Toksook Bay, (g) Kasigluk-Akiuk, and (h) Kwigillingok in the Lower Kuskokwim School District; (a) Anaktuvuk Pass, (b) Atqasuk, (c) Kaktovik, (d) Nuiqsut, (e) Point Hope, (f) Point Lay, and (g)Wainwright in the North Slope Borough School District; (a)Buckland, (b) Kivalina, (c) Selawik, and (d) Shungnak in the Northwest Arctic Borough School District; and (a) New Stuyahok, and (b) Koliganek in the Southwest Region School District. There are 382 or 52.7% of the student participants and 46 or 48.4% of the teacher participants in this category of bandwidth delivery option.

1.7.3.1 Aleutians East Borough School District, Alaska

The Aleutians East Borough School District has an enrollment of 246 students with a certificated staff of 30 in five school communities participating in this study. These school communities are located on the Aleutian Chain, including Akutan, False

Pass, King Cove, Nelson Lagoon, and Sand Point. With the exception of King Cove, all four other schools made Adequate Yearly Progress (AYP) in the 2010-2011 school year. All five schools are considered to be Title 1 schools or low socioeconomic schools identified by the Alaska Department of Education and Early Development (2010). The Aleutians East Borough, based in Sand Point, encompasses an area of approximately 15,000 square miles with no roads connecting their communities. According to the 2010 Census, the community population of 3,141 is approximately 60.4 percent American Indian or Alaska Native, 21 percent White, 12.3 percent Hispanic, 1 percent Black, 5 percent Asian, 0.6 percent Pacific Islander, and 0.3 percent of the local residents identified themselves as multi-racial (U.S. Census Bureau, 2010). While the school district was not part of the AASB-CDL laptop program, they have furnished students and teachers with laptops and participated in the professional development offered by AASB-CDL. The communities in the Aleutians East Borough School District receive their middle-mile internet connectivity via satellite and their last-mile internet delivery via GCI or TelAlaska. Future plans for terrestrial have been identified by the Kodiak Kenai Cable Company to build a high-speed fiber optic cable to the Aleutian Islands with landing points in King Cove; however there is no date projected for this plan.

1.7.3.2 Bristol Bay, Alaska

The Bristol Bay Borough School District is located in Southwest Alaska, at the upper eastern end of Bristol Bay, with an area encompassing about 400 square miles of land and 385 square miles of water, and with no roads going to Bristol Bay. The school community of Naknek High School had an enrollment of 65 students and 4 certificated staff. The high school did not make Adequate Yearly Progress (AYP), in the 2010-2011 school year and is considered to be a Title 1 school or low socioeconomic schools as identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 36 laptops for grades 9-12 in 2008. According to the 2010 Census, the community population of 997 is approximately 33.5 percent American Indian or Alaska Native, 48.2 percent White, 2.4 percent Hispanic, 0.8 percent Asian, 0.3 percent Pacific Islander, and 16.8 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The Bristol Bay Borough School District connected to the internet via middle mile satellite connectivity. In 2012 the school will see terrestrial delivery and the community home access will be terrestrial in 2013 delivered via the GCI TERRA SW network. In addition, future plans for terrestrial have been identified by the Kodiak Kenai Cable Company to build a high-speed fiber optic cable to the Naknek; however there is no date projected for this plan. Currently, the community of Bristol Bay Borough receives their home internet connectivity via Bristol Bay Telephone Company.

1.7.3.3 Kuspuk School District, Alaska

The Kuspuk School district is located along the mid-Kuskokwim River from Lower Kalskag to Stony River and covers over 12,000 square miles, includes seven school communities that participated in this study. These school communities are located in Upper Kalskag, Lower Kalskag, Chuathbaluk, Crooked Creek, Red Devil, Sleetmute, and Aniak. All of these school communities are only accessible by air and river travel. The area population is about 1,775 people and 90-98% of the residents are Yup'ik Eskimo. The K-12 population is approximately 348 students, with a certificated staff of 43. The school district was part of the AASB-CDL program and launched 150 laptops for grades 9-12 in 2006. The school district met Adequate Yearly Progress (AYP) in Aniak, Stony River, Sleetmute, Crooked Creek and Upper Kalskag elementary, but did not meet AYP in Aniak (Jr./Sr. High School), Chuathbaluk, Upper Kalskag (High School), and Lower Kalskag. All schools in Kuspuk School District are considered to be Title 1 schools or low socioeconomic schools as identified by the Alaska Department of Education and Early Development (2010). All of the school communities connect to the internet using satellite for middle mile transport, and GCI and AT&T provide last mile internet connectivity. In 2012, the school district will have access to terrestrial middle-mile connectivity in Aniak, Chuathbaluk, Lower Kalskag, and Upper Kalskag. In 2013, these same school communities will have broadband access via terrestrial fiber and microwave middle-mile connectivity delivered via the GCI TERRA SW network.

1.7.3.4 Lower Kuskokwim School District, Alaska

The Lower Kuskokwim School District is located in western Alaska and is one of the largest rural school districts with schools located across 22,000 square miles, roughly the size of West Virginia. There are a total of 28 schools across 23 communities in the Lower Kuskokwim School District (LKSD) with the district office located in Bethel, Alaska. There are no roads connecting the school communities or villages to the rest of Alaska. The school district had an enrollment of approximately 4,025 students with approximately 375 certificated staff. The school district was part of the AASB-CDL program and launched 234 laptops in 10 schools for grades 8-10 in 2006, and an additional 146 laptops in 5 schools in grades 9-12 in 2008. The school communities represented in this study include Kongiganak, Kwethluk, Napaskiak, Nunapitchuk, Napakiak, Toksook Bay, Kasigluk, and Kwigillingok. All of the school communities in the Lower Kuskokwim School District study receive their middle-mile via satellite connectivity with dialup speeds or up to 256 Kbps download speeds/ 56 Kbps upload speeds delivered by UUI or GCI. In 2012, all of these schools will see terrestrial delivery via fiber and microwave middle-mile and the community home access will be terrestrial via fiber and microwave middle-mile in 2013 via the GCI TERRA SW network.

Kongiganak is located on the west shore of Kuskokwim Bay, lies 70 miles southwest of Bethel with a student population of 142, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 439 represents 96.7 percent American Indian or Alaska Native, 2.1 percent White, 1.8 percent Hispanic, and 2.3 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

Kwethluk is located 12 air miles east of Bethel on the Kwethluk River at the junction with the Kuskokwim River. It is the second largest community along the Lower Kuskokwim River, and encompasses an area of 10 square miles of land and 1.7 miles of water with no roads connecting it the rest of Alaska. The school in Kwethluk has a student population of 246, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 721 represents 94.2 percent American Indian or Alaska Native, 2.2 percent White, 0.1 percent Asian, and 3.5 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

Napaskiak is located on the east bank of the Kuskokwim River about 7 miles southeast of Bethel. It encompasses 3.5 square miles of land and 0.4 square miles of water and there are no roads connecting it to the rest of Alaska. The school in Napaskiak has a student population of 28, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 405 represents 96.5 percent American Indian or Alaska Native, 3 percent White, and .5 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

Nunapitchuk is located on both banks of the Johnson River, 22 miles northwest of Bethel in the Yukon-Kuskokwim Delta. It encompasses 7.9 square miles of land and 0.7 square miles of water and there are no roads connecting it to the rest of Alaska. The school in Nunapitchuk has a student population of 178, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 496, represents 95.8 percent American Indian or Alaska Native, 2.4 percent White, and 1.8 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

Napakiak is located on the north bank of the Kuskokwim River about 15 miles southwest of Bethel. It encompasses 4.7 square miles of land and 0.3 square miles of water and there are no roads connecting it to the rest of Alaska. The school in Napakiak has a student population of 103, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 354 represents 97.2 percent American Indian or Alaska Native, and 2.8 percent White (U.S. Census Bureau, 2010).

Toksook Bay is one of the three villages located on Nelson Island, which lies 115 miles northwest of Bethel. The area encompasses 33.1 square miles of land and 40.9 square miles of water with no roads connecting it the rest of Alaska. The school in Toksook Bay has a student population of 219, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 590, represents 92 percent American Indian or Alaska Native, 4.4 percent White, 0.3 percent Black, 0.2 percent Asian, 1 percent Hispanic, and 2 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

Kasigluk is located on the Johnson River in the Kuskokwim River Delta, about 26 miles northwest of Bethel. The school in Kasigluk has a student population of 80, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 569 represents 94.7 percent American Indian or Alaska Native, 3.3 percent White, 0.2 percent Hispanic, and 1.9 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

Kwigillingok is located on the western shore of the Kuskokwim Bay near the mouth of the Kuskokwim River and lies about 77 miles southwest of Bethel. The school in Kwigillingok has a student population of 109 and did not meet AYP, in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 321 represents 95 percent American Indian or Alaska Native, 3.4 percent White, and 1.6 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

1.7.3.5 North Slope Borough School District, Alaska

The North Slope Borough School District is located in the largest borough in the state of Alaska and encompasses over 88,000 square miles of land and 5,900 square miles of water, located on the north and northeastern coast of Alaska. There are no roads connecting the school communities or villages to the rest of Alaska. The school district is made up of school communities located in Barrow, Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Point Hope, and Wainwright. The school district had an enrollment of 1,605 students with a certificated staff of 171. The schools in Anaktuvuk Pass, Atqasuk, Kaktovik, Nuiqsut, Point Hope, Point, Lay, and Wainwright did not make AYP in the 2010-2011 school year. Schools in Atqasuk, Point Hope, and Wainwright are considered Title 1 schools and have a low socioeconomic status identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 1,756 laptops for grades 1-12 in 2006, making them the largest implementation of one-to-one laptops in the state. According to the 2010 Census, the community population has approximately 2,500 residents with 54.1 percent American Indian or Alaska Native, 33.4 percent White, 1 percent Black, 4.5 percent Asian, 2.6 percent Hispanic, and 5.2 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The entire school district connects to the internet via satellite middle mile connectivity, with last mile provided by GCI. Future plans for terrestrial have been identified by the Kodiak Kenai Cable Company to build a high-speed fiber optic cable around the western coast of Alaska with a landing point in Barrow, connecting to Prudhoe Bay, however there is no date projected for this plan.

1.7.3.6 Northwest Arctic Borough School District

The Northwest Arctic Borough School District is located in the second largest borough in the state of Alaska and encompasses approximately 39,000 square miles of land and 4,800 square miles of water. The school communities are located along the Kotzebue Sound and Wulik, Noatak, Kobuk, Selawik, Buckland and Kugruk Rivers. There are no roads connecting the region to the rest of Alaska. The school district had an enrollment of 1,783 students with a certificated staff of 171 and made AYP in one of their 12 schools during 2010-2011. The school communities participating in this study include Buckland, Kivalina, Selawik, and Shungnak. All of these schools are considered Title 1 schools and have a low socioeconomic status identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 112 laptops for grades 9-12 in 2008. According to the 2010 Census, the community population is approximately 2,707 with 81.4 percent American Indian or Alaska Native, 11.2 percent White, 0.5 percent Black, 0.6 percent Asian, 0.8 percent Hispanic, and 6 percent identified themselves as multi-racial (U.S. Census Bureau, 2010). The entire school district connects to the internet via satellite middle-mile connectivity with last-mile internet connectivity provided by GCI or Inutek. Future plans for terrestrial have been identified by the Kodiak Kenai Cable Company to build a high-speed fiber optic cable around the western coast of Alaska with a landing point in Kotzebue to Barrow, connecting to Prudhoe Bay. GCI also has a plan to continue the TERRA SW network via fiber and microwave to Kotzebue and surrounding villages in the Northwest Arctic Borough. However there is no date projected for either of these plans.

1.7.3.7 Southwest Region School District, Alaska

The Southwest Region School District is located on the Bering Sea coast of southwestern Alaska, bordered by the Bristol Bay to the south. The school district has schools in Aleknagik, Clarks Point, Ekwok, Koliganek, Manokotak, New Stuyahok, Togiak, Twin Hills, and the district office in Dillingham. The school communities participating in this study include Koliganek and New Stuyahok. Both schools did not meet AYP in the 2010-2011 school year and are considered Title 1 schools with a low socioeconomic status identified by the Alaska Department of Education and Early Development (2010). The school district was part of the AASB-CDL program and launched 217 laptops for grades 6-12 in four schools, in 2006. All of the school communities in the Southwest Region School District study receive their middle-mile via satellite connectivity with dialup speeds or up to 256 Kbps download speeds/56 Kbps upload speeds delivered by UUI or GCI. In 2012, all of these schools will have terrestrial delivery via fiber and microwave middle-mile and the community home access will be terrestrial via fiber and microwave middle-mile in 2013 via the GCI TERRA SW network.

Koliganek is located on the left bank of the Nushagak River and lies 65 miles northeast of Dillingham. The village hopes to get its own zip code, but currently shares one with Dillingham. The school in Koliganek has a student population of 56, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 209 represents 95.7 percent American Indian or Alaska Native, 3.4 percent White, and 1 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

New Stuyahok is located on the Nushagak River, about 12 miles upriver from Ekwok and 52 miles northeast of Dillingham. It encompasses 32.6 square miles of land and 2.0 square miles of water and there are no roads connecting it to the rest of Alaska. The school in New Stuyahok has a student population of 149, did not meet AYP in the 2010-2011 school year, and is considered a Title I school and low socioeconomic school identified by the Alaska Department of Education and Early Development (2010). According to the 2010 Census, the community population of 510 represents 93.5 percent American Indian or Alaska Native, 3.5 percent White, 0.2 percent Pacific Islander, 1.2 percent Hispanic, and 2.8 percent identified themselves as multi-racial (U.S. Census Bureau, 2010).

Chapter one provides the backdrop to the study. The nature and topic of this study requires both education and telecommunications terms that may not be understood, therefore a glossary of terms can be found in Appendix C.

Chapter 2: Review of Literature

The purpose and intent for a substantive and thorough literature review is to advance the researchers understanding of the topic to examine the weaknesses of existing studies, and to understand the context of the research to build on the work of the current research (Boote & Belle, 2005). The review of literature is designed to provide the reader with the empirical research to support the research questions of this study. Creswell suggests the researcher use the literature review to showcase results from similar studies, and to use the literature review as a framework for comparing those results with those of the researchers (Creswell, 2009). Others argue that the researcher use the literature review to take on the role of critic (Lather, 1999).

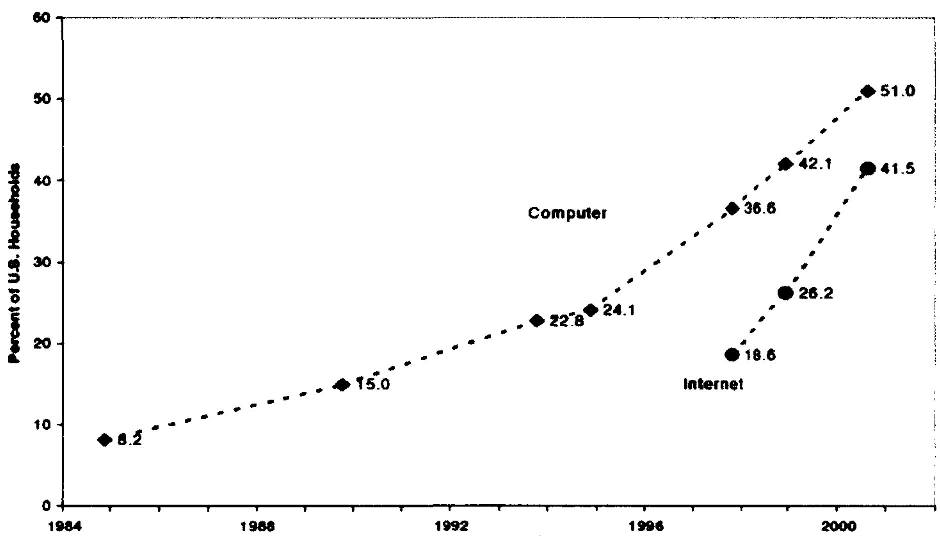
Four broad categories in the literature review provide relevance to this study. The first broad area of literature reviewed provides an understanding of the context that broadband plays in creating sustainable economic conditions for growth and prosperity. The second area of literature reviewed focuses on the barriers of digital equity for implementing one-to-one laptop programs. The third area focuses on previous implementations of one-to-one laptop programs across the nation and lessons learned. Lastly, the fourth area of literature review focuses on home access and student use in one-to-one laptop programs.

2.1 Broadband and the Digital Divide in the United States

This section provides an overview of the broadband initiatives in the U.S. and Alaska, including an overview of the federal grant/loan programs to support broadband mapping, the adoption of broadband, and infrastructure for broadband for Alaskans.

2.1.1 National Telecommunication and Information Administration.

The NTIA (2000, 2010) originally coined the term digital divide to show inequity in access to computers and the internet, and, can be found in the many government surveys conducted throughout the last two decades. The NTIA 2000 report, "Falling through the Net," focused on technology tools necessary for the nation to prosper in the digital economy. The goal for the U.S. Department of Commerce in 2000 was to ensure that all Americans, regardless of age, income, race, ethnicity, disability, or geography had access to the tools and skills necessary for full digital inclusion. The NTIA (2000) report was the fourth report focusing on the implications of the digital divide on the nation's economy. The findings in 2000 showed groups traditionally labeled as the have-nots of the digital divide were making dramatic gains; however, large gaps were still prevalent with minority racial groups and people with disabilities, Americans purchased home computers at a rapid rate between 1998 and 2000. In 1998, only 60% of Americans had internet access and a computer. In 2000, the number of American's with internet access grew to more than 80% as shown in Figure 6 (NTIA, 2000).



Source: NTIA and ESA, U.S. Department of Commerce, using U.S. Bureau of the Census Current Population Survey supplements.

Figure 6. Percent of U.S. households with a computer and internet access.

Another dramatic change from 1998 to 2000 occurred in narrowing the divide between rural and urban households. In 2000, the technological infrastructure changes were rapidly changing the digital landscape for consumers of the internet. The development of infrastructure allowed for faster transmission speeds and wider bandwidth. The term broadband was born, with approximately 4.5% of all U.S. households having broadband speed access (National Telecommunications and Information Administration, 2000). Rural areas showed an increase of 75% from 1998 to 2000 as shown in Figure 7 (NTIA, 2000).

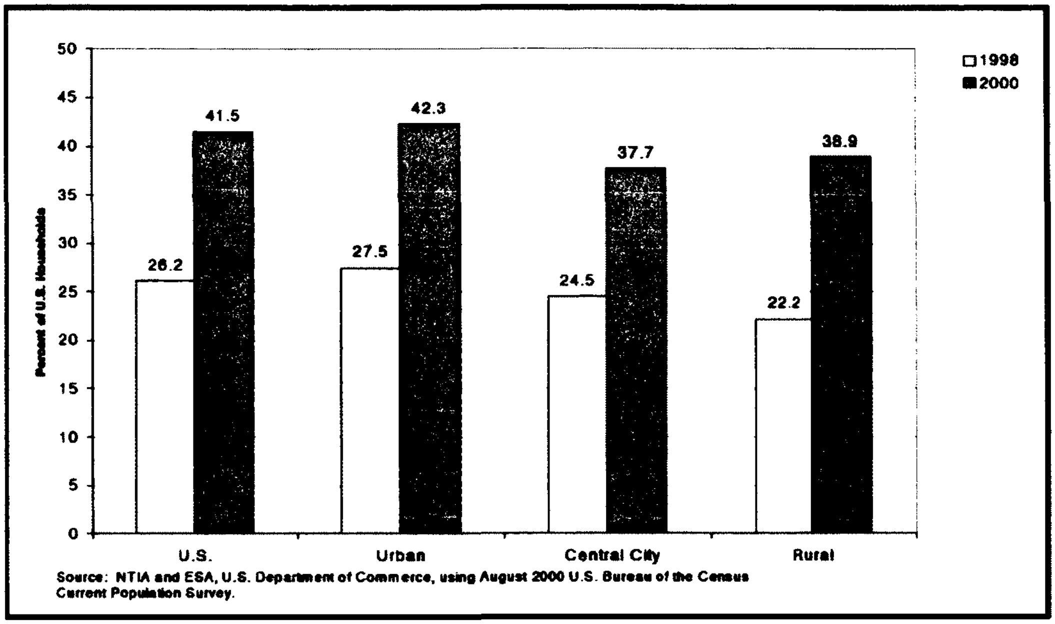


Figure 7. Percent of U.S. households with internet access.

Fast forward to 2004, NTIA's report titled, "A Nation Online: Entering the Broadband Age," reported on the nation's productivity and economic competiveness with specific focus on education and healthcare to "erase geographic, economic, and cultural gaps" (Cooper & Gallagher, 2004, p. 10). With the continued growth in technological advances, cable modems, digital subscriber lines (DSL), and the promise of satellite technologies, more U.S. households were able to join the ranks in accessing the internet via broadband speeds, creating the highest growth in household broadband connectivity, more than computer ownership, and for the first time, dial-up connections declined. Online behavior moved from email communication to e-commerce, with online banking coupled with online purchases of goods and services leading the way (Cooper & Gallagher, 2004).

In 2010, the NTIA study, titled "Digital Nation: 21st Century America's Progress Toward Universal Broadband Internet Access, examined broadband adoption in virtually all demographic groups. The data revealed disparities among groups of people identified to have high incomes, younger generations, Asians and Whites, and the more educated, as having high broadband access compared to those groups of people categorized as low income, senior citizens, minorities, the less-educated, and non-family households who lagged behind use and adoption (National Telecommunications and Information Administration, 2010). The National Broadband Plan depicts various levels of adoption by demographic groups as shown in Figure 8 (Federal Communication Commission, 2010).

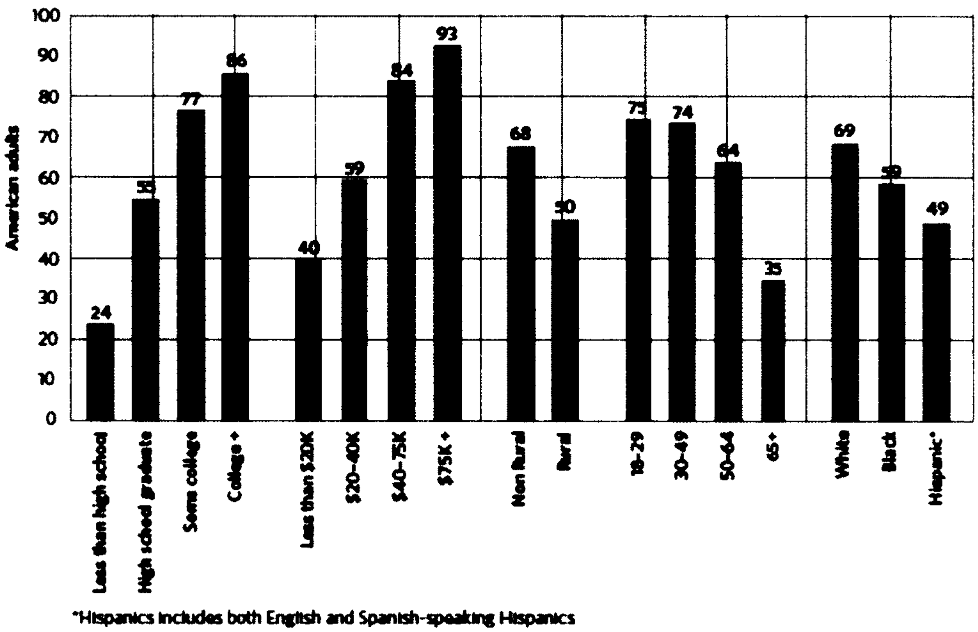


Figure 8. Broadband adoption by American adults.

2.1.2 Connecting America: The National Broadband Plan.

> For too long, the geographic limitations of one's life have determined access to many critical resources, including employment, schools, and services. Too often, we can predict the outcome of children's lives by the ZIP code in which they live. (Federal Communication Commission, 2010, p. ix)

In early 2009, the United States Congress directed the FCC to develop a National Broadband Plan to ensure every American has "access to broadband capability" (Federal Communication Commission, 2010, p. ix). The FCC started the process for creating America's National Broadband Plan by providing a forum for community input through 36 public workshops with over 10,000 participants. In 2010, the FCC laid out a strategic plan for broadband in America in response to the NTIA reports. The national broadband plan was created to provide the roadmap for America to compete globally and to create opportunity in the U.S. The plan required the government to influence the broadband ecosystem in four ways: (a) design policies to ensure robust competition; (b) ensure efficient allocation and management of assets in reference to spectrum, poles; right-of-ways, to encourage network upgrades and competitive entry; (c) reform current universal service mechanisms to support deployment of broadband and voice in high-cost areas, ensuring low-income Americans can afford broadband, while supporting adoption and utilization; and (d) reform laws, policies, standards and incentives to maximize the benefits of broadband in public education, health care, and government (Federal Communication Commission, 2010).

The FCC took more than 74,000 pages of public comments from across the country to create America's Broadband Plan to lay the foundation for a roadmap to fulfill the mandate directed by Congress. The plan laid out goals and recommendations to ensure all Americans had access to broadband.

The six goals for a high performing America as outlined in the plan, include: (a) at least 100 million U.S. homes should have affordable access to actual download speeds of at least 100 megabits per second and actual upload speeds of at least 50 megabits per second; (b) the United States should lead the world in mobile innovation, with the fastest and most extensive networks of any nation; (c) every American should have affordable access to robust broadband service, and the means and skills to subscribe if they so choose; (d) every American community should have affordable access to at least 1 gigabit per second broadband service to anchor institutions such as schools, hospitals, and government buildings; (e) to ensure the safety of the American people, every first responder should have access to nationwide, wireless, interoperable broadband public safety network; and (f) to ensure that America leads in the clean energy economy, every American should be able to use broadband to track and manage their real-time energy consumption. Each of these goals has specific recommendations to include, (a) ensuring a robust broadband ecosystem for both fixed and mobile network services by maximizing innovation, investment, and consumer welfare, primarily through competition. In addition, the plan recommends more government efficiencies for the management of assets like spectrum, poles, and right-of-ways, in order to maximize the investment of private sectors to facilitate competition; (b) to promote inclusion for all Americans to have access to opportunities by reforming the Universal Service Fund (USF) to promote digital literacy, adoption and broadband affordability; and (c) to maximize the benefits of broadband in health care, education, energy, and government. All of these recommendations include implementation strategies and are laid out in the plan in order to create an economically competitive America (Federal Communication Commission, 2010).

In 2010, nearly 100 million Americans did not have broadband in their home, and approximately 14 million Americans did not live in an area where broadband infrastructure was available. Additionally, over 10 million school-aged children did not have home access to broadband (Horrigan, 2010).

2.2 Broadband and Alaska

The National Broadband Plan created the impetus for the National Telecommunications and Information Administration (NTIA) and the American Recovery and Reinvestment Act (ARRA) to provide funds through grants and loans to private and public sectors. These grant/subsidies supported the goals of the National Broadband Plan in three areas to include: (a) broadband mapping; (b) broadband adoption; and (c) broadband access. Alaska was successful in applying for and receiving funds in all three categories of funding support. The efforts and timeline for these programs occurred in parallel with this research study and each of the entities described below were recipients of funding that will have a significant impact on the digital landscape for Alaska.

2.2.1 Broadband mapping.

In 2009 the ARRA worked with NTIA to seek applications from interested parties to provide broadband-mapping across the U.S. in response to Congress' mandate for all Americans to have broadband in the home (Federal Communication Commission, 2010). The act required that NTIA make the map accessible to the public by February 17, 2011.

Connected Nation, a non-profit corporation focused solely on closing the digital divide began its first statewide broadband inventory-mapping project in Kentucky in 2005. Connected Nation applied for the stimulus funding to implement a national broadband mapping project, following the model created in Kentucky. To-date, Connected Nation has supplied data to the NTIA for 13 jurisdictions including Alaska.

Connect Alaska, a subsidiary of Connected Nation, was created in 2010 using the initial funding of $1.4 million for broadband planning activities and two years of data collection. In September 2010, Connect Alaska received an additional $4.6 million to identify and implement best practices. Connect Alaska began its initial research via a voluntary collaborative process, and was able to gather information from Alaska's 22 of 23 internet service providers to identify the delivery methods and topology for all of Alaska's communities. At the beginning of this study, meetings with Brian Mefford, CEO for Connected Nation occurred. Conversations referencing the formation of Connect Alaska to conduct the broadband mapping project coupled with the role of the internet Service Providers in the state continued throughout the timeframe for this study.

While Connect Alaska began its first telephone surveys in Alaska, another organization, the Alaska Broadband Task Force (ABTF) was beginning to formalize a strategic broadband plan for the state of Alaska. The ABTF is made up of 21 members from across Alaska in both public and private sectors. Members include legislators, state administration, non-profit organizations and telecommunication providers. The goal for the Alaska Broadband Task Force is to extend the full benefits of broadband technology to every Alaskan. The ABTF was instrumental in this study as they provided information about the middle mile connectivity for all communities in Alaska.

In 2011, Connect Alaska reported on trends in Alaskan Residential Technology Adoption using data from surveys taken in 2010 and 2011, compared to national trends. Connect Alaska conducted random telephone surveys. Connect Alaska conducted a random telephone survey to 1,200 adults across Alaska based on census area population demographics. An additional 1,751 adults who did not subscribe to home broadband service were selected to further explore the reasons or barriers for choosing not to adopt broadband service in the home as well as their willingness to subscribe to home broadband in the future. Survey respondents were selected from rural and non-rural areas in Alaska and coincided with the 2010 United States Census population figures. Rural respondents were categorized as living in a borough/census area that is not part of a Metropolitan Statistical Area. While Connect Alaska reported 88% of Alaskan adults own a computer, and nearly three out of four Alaskan residents subscribed to broadband internet access in the home, they also reported approximately 61,000 Alaskan adults did not have a home computer and 141,000 were without home broadband service as shown in Figure 9 (Connect Alaska, 2011).

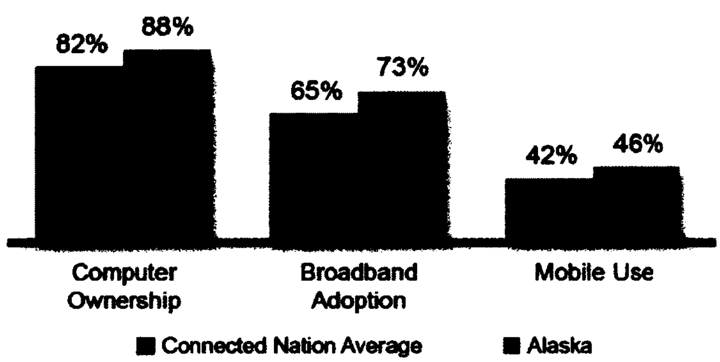


Figure 9. Connect Alaska Residential Technology Trends.

Connect Alaska reported 2010 and 2011 data comparisons for both broadband adoption and computer ownership as declining in 2011, a trend reported nationwide. Reasons cited for this decline were attributed to the economy and potential mobile broadband adoption as a substitute for home broadband connection (Connect Alaska, 2011). Broadband adoption and computer ownership comparisons are shown in Figure 10 (Connect Alaska, 2011).

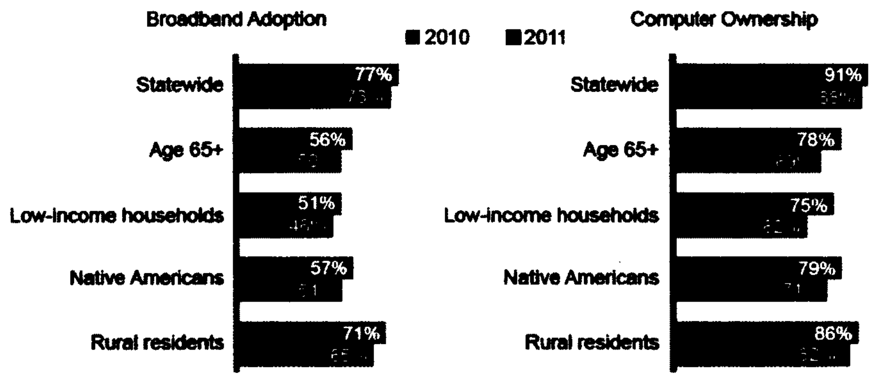


Figure 10. Connect Alaska residential technology adoption trends.

Connect Alaska reported demographic trends in Native Alaskans declined from 2010 to 2011. It was estimated that approximately 35,000 Native Alaskan adults did not have broadband internet access in the home across the state. There was no information regarding the survey participants from 2010 to 2011 as to whether data was taken from the same or different respondents (Connect Alaska, 2010, 2011).

2.2.2 Broadband adoption and sustainability.

The University of Alaska Fairbanks received a $4.5 million award to break down the digital divide in remote villages across Alaska. The goals for the grant were to bridge the e-skills gap in Alaska, using a three-pronged approach to increase sustainable broadband adoption. The University partnered with 21 non-profit, educational and for-profit organizations to create distance learning, public safety, and tele-health opportunities with a goal to provide as many as 7,400 residents relevant content and services (NTIA, 2010).

2.2.3 Broadband infrastructure in rural Alaska.

In 2010, United Utilities, Inc. (UUI), and General Communications Inc. (GCI), received a federal grant, jointly funded from United States Division of Agriculture, (USDA) Rural Utilities Service (RUS) and ARRA, for $44 million, with an additional $44 million in the form of a loan to build a terrestrial communications network in Southwest Alaska. This network, originally scheduled for completion in 2013 has been completed two years ahead of schedule and will be used by anchor tenants, including school districts, hospitals, and clinics in January 2012. This high-speed network, which provides the first ever fiber optic and microwave connection to Southwest Alaska, a region roughly the size of North Dakota is known as Terrestrial for Every Region of Rural Alaska (TERRA). The map of this high-speed network is shown in Figure 11 (GCI, 2009).

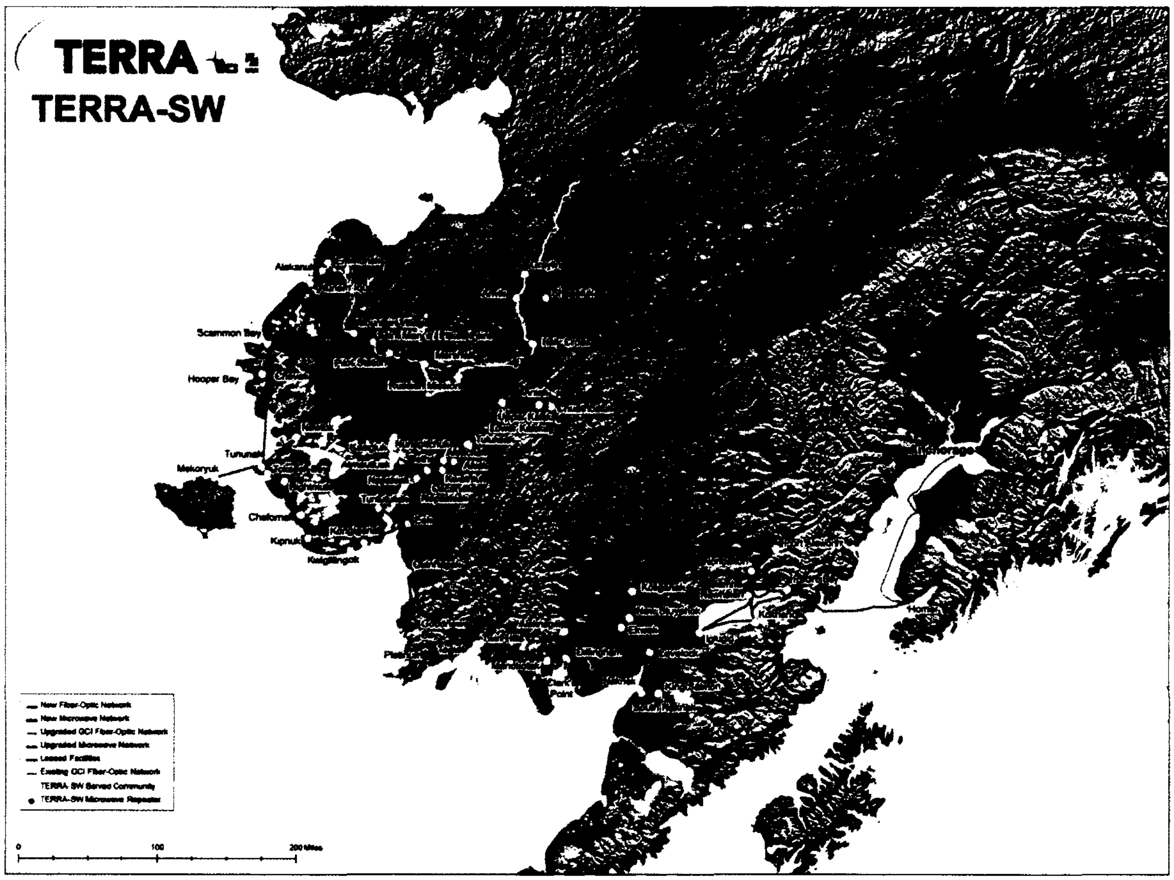


Figure 11. TERRA Southwest map.

This service area is linked to the internet backbone primarily by two private satellite networks and currently the only community in this area that has broadband speed available is Bethel, Alaska, a regional hub about 340 miles west of Anchorage, only accessible by air and river, with an estimated population of 7,000. At the time of the RUS/ARRA application in 2009, there were only 58 households receiving 1.5 Mbps download speed and 256 Kbps upload speed as identified in the grant application by United Utilities, Inc. The remainder of the population, living in 64 villages identified in the project, was categorized as having speeds that were at or just above dialup. This new high-speed terrestrial network is scheduled to provide all 65 communities with terrestrial broadband speeds by 2013 (GCI, 2009) .

This section summarizes the U.S. landscape and government influence on broadband access. The next section of the literature review addresses the implications for a society of have and have-nots in reference to broadband availability and access to infrastructure, also known as the digital divide.

2.3 Social Ethics and the Digital Divide

For years, researchers have sought to explain the digital divide as a social equity issue focused on physical access to computers (Dickard, 2002; Fulton & Sibley, 2003; Hacker & Mason, 2003; Kvasny, 2002; J. Robinson, DiMaggio, & Hargittai, 2003). Statistical analyses and reports on the digital divide have provided much research with reports on demographic gaps in computer use and internet access. These studies have been used to provoke public policy through political advocacy and to equate the claims referencing the digital divide to be nothing more than political and ideological groups, using the reports to influence government policies (Hacker & Mason, 2003).

Adding ethical assessments to the data analysis to provide a complete picture of communication technology and the gaps present in a democratic society are key to understanding the dynamic nature of the digital divide. Simply reporting on usage does not provide a complete picture, as the gaps in the digital divide are more than the physical access to a computer connected to the internet (Hacker & Mason, 2003; Wilhelm, 2003).

Hacker and Mason (2003) believe, there are three ethical areas that have been neglected in the research of the digital divide. Those areas include: (a) data summaries are missing methodological details, generalizations of skills, and internet usage; (b) the ethical issue of arguing that the digital divide results from people not wanting to adopt rather than those that do not have access; and (c) the ethical problem of reinforcing stereotypes of lagging groups (Hacker & Mason, 2003).

> The digital divide is political in nature and has been framed in three ways: (a) how much the digitally included and excluded differ in participation and benefits; (b) whether or not there are structural inequalities correspondent to various gaps; and (c) what the role of government should be in relation to facilitating more digital inclusion. (Hacker & Mason, 2003, p. 13)

Claims that the digital divide is present or not present in the U.S. have largely been related to the political ideology of the current administration. The NTIA (2000) report provided data to show Americans were already online, causing the Bush administration to eliminate Technology Opportunity and the Community Technology Center programs, both providing grants to under-served rural areas (Dickard, 2002). NTIA reporting, while valid, does not provide a complete analysis of the digital divide. Researchers believe the NTIA reports define the internet access with a broad brush and only focus on the machine or actual access. In addition, NTIA reports are tied to social policy and may provide justification or interpretive comments that form policy (Dickard, 2002; Dijk, 2000; Hacker & Mason, 2003).

Compaine (2001) argues that there will always be a divide, largely due to the nature of technology in that early adopters will subsidize the late adopters, whether it be computers, internet access, or automobiles, and there is no need for policymakers to intervene in closing the digital divide. In contrast, Rogers (1986), whose Diffusion of Innovation theory claims that the gap widens between the information rich and information poor, believes that new communication technologies or innovations in technology should be at the forefront of policymakers, as such, policies that allow market forces to continue without interference will result in larger gaps and unequal access between the information poor and the information rich. Technology is not static, but dynamic in nature, in that, by the time the conditions in the market for technology close one gap, another will be opened, and the information inequality actually increases.

Hacker & Mason (2003), view the digital divide debate as a moral issue. Given the importance of information and communication technologies, society has a moral obligation to remove digital exclusion among groups of citizens, treating information and communication as a right, rather than a privilege As such, Hacker & Mason believe that internet access and use should not be considered a luxury for the information rich, but instead, should be considered critical tools for living in the digital world. The argument as to whether the digital divide gaps will close themselves or that the gaps will continue to persist creates a strong ethical issue that moves beyond simple longitudinal trends that are shown as snapshot studies (Kvasny & Keil, 2006).

2.3.1 Understanding social inequalities in the digital divide.

Researchers argue that focusing on closing the digital divide is merely one area that should be emphasized by policymakers and researchers. J. Robinson et al., (2003), suggests there are various dimensions in describing the digital divide, and that the term "digital inequality" better explains the core issue society is facing, even after computer and internet access gaps have been resolved (Tolbert & Mossberger, 2006). Various scholars have sought to explain the digital divide through different types of internet use, suggesting there are three distinct levels of digital divide that include: (a) the divide between industrialized and lesser developed nations referred to as the global divide; (b) the divide or inequalities among populations within one country, referred to as the social divide; and (c) the divide among the population of people within a society that use and do not use digital technologies to participate or engage in public life, referred to as the democratic divide (Norris, Sullivan, Poirot, & Soloway, 2003; J. Robinson et al., 2003). Warschauer, Knobel, & Stone, (2004), sought to extend the definition of digital inequalities beyond the physical ownership of computer or internet access to include factors like content, language, literacy, and the educational ways in which the technologies are being used.

J. Robinson et al., (2003) discussed the potential implications for inequality in the use of the internet when approaches to close the digital divide gap, merely focused on connectivity. They believed the following measures should be incorporated into understanding the digital inequality analyses. Those measures or factors contribute to the skill of the individual and include: (a) technical means or quality of the equipment; (b) autonomy of use; (c) social support networks; and (d) experience. The technical means to include equipment quality and reliable internet access at work and home contribute to a higher sophistication in using digital resources compared to those groups that do not have the technical means. User groups with less technical means become frustrated and spend less time in the medium of digital resources. In addition, those groups that have autonomy of use connected both at home and work, are more likely to use online resources and enhance their online skills. The literature on the diffusion of innovation (Rogers, 2003), supports the premise that Hargittai's (2003) social support networks enhance the adoption level of new technologies. A study based on diffusion of home computer use found that the lack of social networks decreased the behavior of groups giving up on technology (Murdock, Harmann, & Gray, 1992). Lastly, experience related to the amount of time user groups are investing in technology and online resources have a much higher likelihood in acquiring online skills and digital literacy affording the opportunity to participate in the digital knowledge economy. All of these factors contribute to the potential implications of the internet as it pertains to social inequalities and must be addressed along with longitudinal data that merely addresses computer use and internet access (DiMaggio, Hargittai, Celeste, & Shafer, 2004; Hargittai, 2003; J. Robinson et al., 2003).

2.3.2 Deconstructing the digital divide in education.

While initial research on technology and equity focused on unequal access to computers and internet in home and school settings, the distribution or ratio of computers to students over the past decade has narrowed the gap in access to computers (Warschauer et al., 2004). Increasing technology access in schools has been the answer in closing the digital divide in education (Kane, Beals, Valeau, & Johnson, 2004; Parker, 2006). In fall, 2008, an estimated 100 percent of public schools had a minimum of one computer connected to the internet with a ratio of computers connected to the internet to students of one computer to three students (NCES, 2008).

Research on technology and equity in the classroom began to shift in the paradigm of access to computers and internet to equitable use and contribution to student learning. Schofield and Davidson's (2001) qualitative study documented inequalities in online student use, focusing on who is accessing the internet in schools. Online access was given to advanced students as a reward for completing work, while others were not given those same opportunities (Parker, 2006; Schofield & Davidson, 2001; Warschauer, Knobel, & Stone, 2002). In H. J. Becker's (2000a) report comparing high socioeconomic status (SES) and low-SES students use of computers both in school and at home, he analyzed school use by subject area for both student groups. The reports showed mixed results for low-SES students use of the computer. Low-SES students used their computers more than high-SES students in the area of mathematics and English classes, and computer drill and practice applications were more common uses for low-SES students. On the contrary, high-SES students used the computer for simulations and research in science curriculum, while low-SES students were more likely to use the computers for remediation applications (H. J. Becker, 2000a). The digital divide is no longer about the inequities in the access to the internet or computer use, but instead, schools today are grasping the magnitude of the inequalities on how computers are used for student learning (Warschauer et al., 2004).

2.3.3 Digital equity in education.

Framing the digital divide in education to include only unequal access to digital technology does not consider the digital equity beyond the physical access to the internet and computer. The economic and technological advances have transformed the digital age and educators have turned to the infusion of technology to address the challenges of the 21st century gaps in literacy and learning achievement of students (Warschauer, 2008). Lack of access means barriers for educational opportunities (Hammond, Love, Baldwin, & Chen, 2008).

> Digital equity in education means ensuring every student, regardless of their socioeconomic status, language, race, gender, geography, physical restrictions, cultural background, or other

> attribute historically associated with inequities, has equitable access to advanced technologies, communication and information resources, and the learning experiences they provide. (Fulton & Sibley, 2003, p. 19)

Educators mostly agree that computer access and internet use are vital to educating students in the 21st century, and much of the earlier Federal and State policies for education technology, focused on the equitable distribution of education technology resources. However, there is continued focus on the disparities among different groups of students and the inequity in computer and internet use for learning (H. J. Becker, 2000a, 2000b; DeBell & Chapman, 2003; Fulton & Sibley, 2003; Judge, Puckett, & Bell, 2006). Both H. J. Becker (2000a) and Warschauer et al., (2004) in separate quantitative and qualitative studies had similar findings referencing digital inequities in how technology is distributed to and used for among different groups of students (H. J. Becker, 2000a; Warschauer et al., 2004). J. D. Becker's (2006) study reports that teachers of low-achieving students used more drill-and-practice type software, while high-SES classrooms used more simulations and focused on research.

2.4 Ubiquitous Computing through One-to-One Laptop Initiatives

Caperton and Papert (1999), visionaries in how technology could transform education, sought to engage policymakers in rethinking what was possible when connecting every student in every classroom to the internet; erasing inequities by providing each child with a computer. They believed technology would change the way students learned, creating a radically different look and feel within the classroom walls. Today, classrooms are connected to the internet and many schools have implemented one-to-one devices, however, the research is not conclusive that the vision these two researchers had for technology to transform the classroom has been realized.

The past decade has been inundated with one-to-one laptop initiatives in schools across the country with several large, complex implementations (Argueta, Huff, Tingen, & Corn, 2011). This has provided a plethora of research studies designed to measure the efficacy of implementation and other factors to support learning in the classroom

(Anderson & Becker, 2001; Lemke, Coughlin, & Reifsneider, 2009; Lemke & Martin, 2003; Penuel, 2006; Penuel et al., 2002; Rockman, 2003; Shapley et al., 2010; Silvernail & Lane, 2004; Warschauer, 2008; Zucker, 2004). Studies of large one-to-one laptop initiatives across the nation have shaped the digital landscape for others to forge ahead in creating learning environments for 21st century students. The ability to create authentic, engaging, and personalized learning systems in technology-rich environments to increase student knowledge and learning continues to be the challenge for education systems across the nation (Fullan, 2007; Jonassen & Reeves, 1996; Rosen, 2011).

Critics, over the years, have suggested that the investment in education technology and resources for student learning have not yielded the results promised and has had no measurable impact on teaching and learning (Cuban, 2001; Cuban, Kirkpatrick, & Peck, 2001; Greaves Group & Hayes Connection, 2006; Oppenheimer, 1997). Findings from these empirical studies have also shown a disconnect between the implementation of technology focusing on using technology to amplify traditional practices in the classroom and using technology to create change (H. J. Becker & Ravitz, 2001; Cuban, 2001; Rosen, 2011; Zucker & Hug, 2007). Implementing a change process for education systems using technology as an innovation tool to create quality learning environments means a school system must make a paradigmatic shift in teaching, learning, assessments, digital curricula aligned with standards to create a school climate conducive to learning (Rosen, 2011).

2.5 Summary of Key Findings in Large One-to-One Laptop Initiatives

To-date, there have been eight major one-to-one laptop implementations across schools in the U.S., including: (a) Virginia's Henrico County School District; (b) Florida's Levering Laptops; (c) Maine's Learning Technology Initiative (MLT); (d) Pennsylvania's Classrooms for the Future (CFF); (e) North Carolina's One-to-One Learning Technology Initiative (NCLTI); (f) Michigan's Freedom to Learn (FTL); (g) Texas's Immersion Pilot (TIP); and (h) Massachusetts' Berkshire Wireless Learning Initiative. Each of these initiatives provided a body of research findings using both qualitative and quantitative methods across a wide area of topics including, (a) student achievement; (b) development of 21st century skills; (c) student and teacher roles; (d) parent involvement; (e) professional development effectiveness; (f) teacher, administrator and student perceptions; and (g) fidelity in implementation (Argueta et al., 2011; Beaudry, 2004; Bebell & Kay, 2009; Corn, 2009; Dawson, Cavanaugh, & Ritzhaupt, 2006; Lowther, Strahl, Zoblotsky, & Huang, 2008; Shapley et al., 2010; Silvernail & Lane, 2004; Zucker, 2005). Data collection methods used in these evaluations is shown in Figure 12 (Argueta et al., 2011).

	Survey*				Interview*						Teacher Observation	Document Analysis (e.g., test scores, rubrics, videos)	Action Research
State	S	T	A	TC	S	T	A	TF	P	DPC			
Florida		X								X	X	X	X
Maine	X	X		X	X	X	X		X		X	X	
Michigan	X	X						X			X	X	
North Carolina	X	X	X					X			X	X	
Pennsylvania	X	X					X				X	X	
Texas	X	X	X		X	X					X	X	
Virginia (Henrico)	X	X	X		X	X	X				X	X	

*Note: S=Student, T=Teacher, A=Administrator, TC=Technology Coordinator, P=Parent, TF=Technology Facilitator, DPC=District Project Coordinator

Figure 12. Data collection methods for large one-to-one laptop initiatives.

2.5.1 Virginia's Henrico County School District.

In 2001, Dr. Mark Edwards, then superintendent for Henrico County School District (HCSD) sought to change the inequities in computer home access with almost half of HCSD students not having access to a computer at home, while the remaining half of the student population having home computers. Secondarily, Dr. Edwards sought to reduce the expense and reliance on textbooks. The HCSD dedicated approximately $20 million to lease 25,000 laptops for teachers and students making them the largest school district in the U.S. to implement a one-to-one solution for its middle and high schools (Zucker, 2005).

In 2003, SRI International (SRI) and Education Development Center (EDC) conducted an evaluation of the implementation of laptop use in mathematics and science with data collected during 2003-2004. This study was valuable in the development of a conceptual research framework for ubiquitous or one-to-one computing. Zucker (2004) believed that having a research framework was important to further the research agenda for one-to-one computing at a systems level (i.e. large district, state implementations) and used the conceptual framework for research in the Henrico study as shown in Figure 13 (Zucker, 2004).

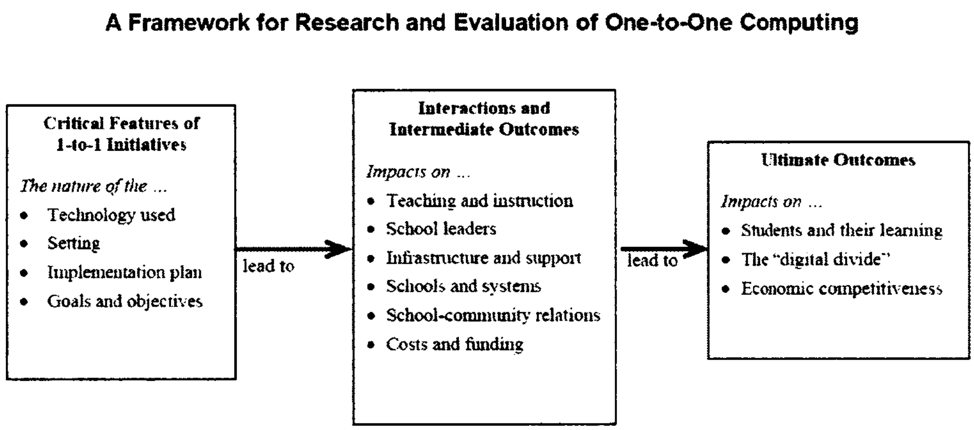


Figure 13. Zucker framework for evaluating one-to-one laptop initiatives.

A research framework is intended to provide an organized model for further research. All one-to-one initiatives are implemented for the same reasons. This framework provides clarity for understanding the relationship between the three boxes within the figure above. The first box on the left identifies the critical features such as technology used, the setting, and goals for the project. The last box on the right identifies the ultimate goals or outcomes. The middle box represents how teachers, administrators, stakeholders make use of the one-to-one initiatives and impacts of that use on teaching and learning (Zucker, 2004).

While the intent for this study was to be mixed methods, teacher and student survey results were not used in the final report due to concerns for potential bias due to low response rates. Qualitative data collected from principals, teachers, students, and parents allowed for focused data to be analyzed through case studies. Due to the nature of the study, the team focused on only those classrooms where laptops were in use and did not seek to gather data from those classrooms where teachers were reluctant to implement the technology. This is a limitation to the study in that generalizations cannot be made across the entire district population.

Key findings showed that laptop use was tied to availability of software, with the most use in English, language arts, science, and social studies. Mobility and portability of the laptop was a positive aspect of the laptop program for use at home and school, and was shared by both students and teachers. Students regularly used laptops at home for research, teacher's supplemental materials, and virtual folders. In addition, students reported that the use of online tutorials was helpful in reviewing lessons and homework at home. Teachers reported greater use in communication with colleagues and parents, better management of student information such as grades, and the laptops provided more opportunities to develop online materials to supplement homework assignments and schoolwork. Despite the challenges found with computer and network failures, respondents felt that the laptops provided students with greater independence, motivation, and better organization (Argueta et al., 2011; Zucker, 2004; Zucker & McGhee, 2005).

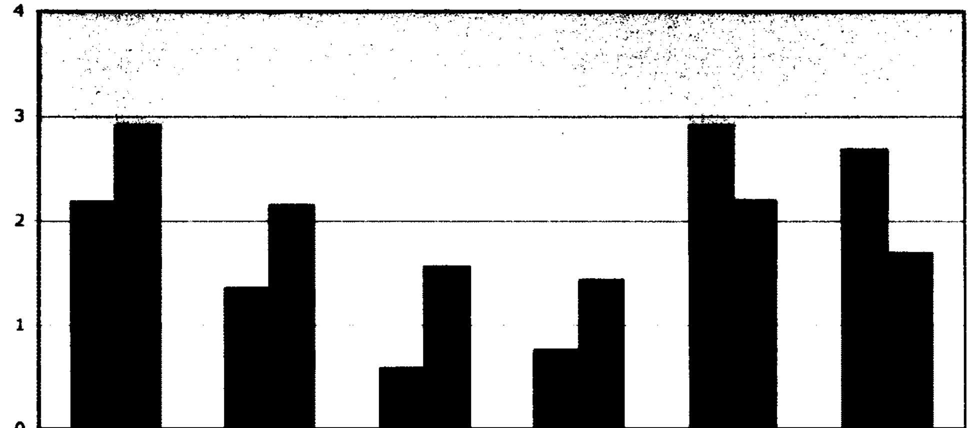
2.5.2 Florida's Leveraging Laptops.

The Florida Department of Education funded Florida's Leveraging Laptops program was funded through the U.S. Department of Education's Title II-D, Enhancing Education through Technology (E2T2) program. The intent for the program was to create models for integrating laptops to enhance student achievement in 47 K-12 schools in 11 districts (Barrios et al., 2004; Cavanaugh, Dawson, & Ritzhaupt, 2008). In October 2003 a task force was assembled to assess and identify best practices in mobile learning environments as they pertain to, (a) student achievement; (b) cost/benefit analysis in anytime, anywhere authentic learning; and (c) equity of educational opportunities for students to have 21st century learning skills (Barrios et al., 2004).

The task force completed a one-year study to identify changes in teaching practices and student learning in 440 K-12 classrooms in eleven districts in Florida with the primary purpose of developing effective models for enhancing student achievement and focus on changes in teaching and learning in a one-to-one learning environment (Cavanaugh et al., 2008). Based on recommendations from the findings in Zucker's study, Florida implemented best practices to include, (a) professional development for teachers emphasizing student-centered, tool-based integration; (b) classrooms had networking capacity and peripheral devices; and (c) classrooms were supported with curriculum and technical support (Bonifaz & Zucker, 2004).

The research team used multiple methods and strategies for data collection including School Observation Measures (SOM) and Survey of Computer Use (SCU) to measure teaching practices in the one-to-one environment (S. Ross, Lowther, & Alberg, 2006). A mixed method approach with data analyzed independently from each strategy across each of the district implementation models was used. A survey for teachers was designed to measure technology integration, support and attitudes toward laptop use. This data was triangulated with qualitative data collected to inform the three questions aligned with the framework developed by Zucker. These included: (a) conditions for the initiative; (b) processes within each school district; and (c) consequences to include student achievement, changes in teacher practice, impact on parents and sustainability of the project.

This mixed method study provided baseline and end-of year differences for each of the categories and strategies identified in the SOM and SCU with a total of 381 hours of classroom observations of 428 teachers and approximately 8500 students in 11 districts. Both SOM and SCU observations showed significant increases from beginning of school year to end of school year. Key findings showed that teachers who implemented meaningful strategies and activities led to students who were more engaged, and using higher-order thinking and problem-solving skills as identified in Figure 14 (S. Ross et al., 2006).



	High Student Attention	Technology as a Learning Tool	Project-based Learning	Independent Research	Direct Instruction	Independent Seatwork
Fall	2.18	1.35	0.59	0.76	2.91	2.68
Spring	2.91	2.15	1.56	1.43	2.19	1.69

Figure 14. Florida learning with laptops SOM.

2.5.3 Maine's Learning Technology Initiative.

Maine implemented one of the largest one-to-one laptop initiatives in the nation with the focus on innovation as a key role in the economic future for the residents of Maine. In 2002, Maine rolled out laptops to 17,000 seventh graders and their teachers in over 240 schools with the goal to increase student achievement with an emphasis in mathematics, develop 21st century skills, and close the digital divide (Beaudry, 2004; Gravelle, 2003; Silvernail & Lane, 2004). In 2003, the Maine Learning Technology Initiative (MLTI) added eighth grade students and teachers to the program, bringing the total laptop deployment to almost 3,000 teachers and over 34,000 students (Silvernail & Lane, 2004). There have been a series of studies and reports on the MLTI spanning 2003 to present. Silvernail and Lane (2004) provided longitudinal data through statewide evaluations using mixed methods data collection strategies. Research data comprised of 301 interviews with administrators, teachers, students, and parents from 23 schools, as well as 22 classroom observations from 7 schools. In addition, a statewide survey was sent to all teachers, students, and technology coordinators across the state.

Key findings from Silvernail and Lane (2004) revealed benefits beyond the initial goals for the program with data revealing a shift in teacher and student roles within months of implementation of the MLTI program. These results may have partially been impacted by the limited time teachers had to incorporate the technology into the classroom as they received their laptops the summer before students arrived. Teaching and learning in the classroom was transformed and the studies revealed the following changes in pedagogy provided: (a) increased interaction with adults when students assisted teachers; (b) increased collaboration with peers when students assisted other students; (c) increased student impact on learning tasks, with students able to contribute to information resources on the web; and (d) increased opportunities for individualized learning (Lemke & Martin, 2003; Silvernail & Lane, 2004).

The Maine Education Policy Research Institute (MEPRI) was contracted to conduct on-going evaluations of the MLTI. In 2011, a report provided research findings to show the MLTI had significant gains in the area of instruction, curriculum and learning in Maine's middle schools, however, there was an uneven adoption and integration of the laptop among some teachers in some content areas, specifically mathematics and the area of 21st century skills. The report revealed some evidence on student achievement in the area of writing and that when instruction was executed in a well-designed, meaningful way, student achievement in mathematics occurred. The report also showed a change in pedagogy with teachers' beliefs that they had shifted from teacher-centered teaching to student-centered learning as shown in Figure 15 (Silvernail, Pinkham, Wintle, Walker, & Bartlett, 2011).

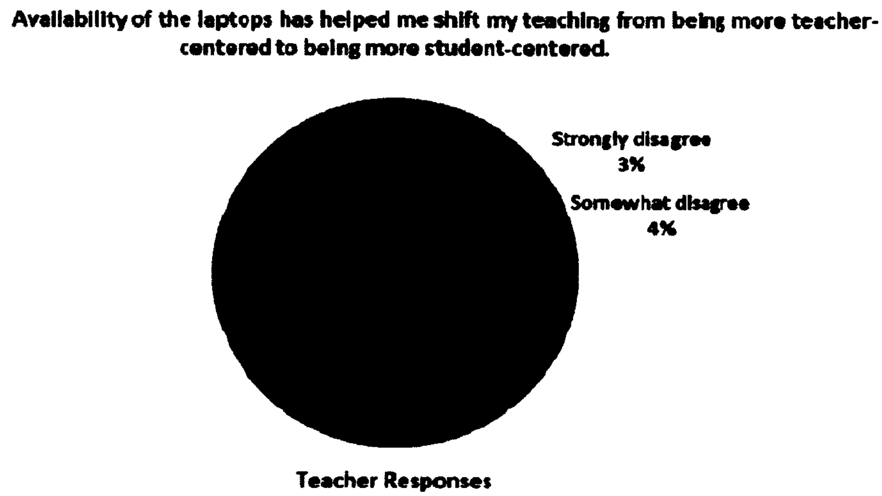


Figure 15. Teacher shift from teacher-centered to student-centered.

Student achievement findings were mixed, largely due to inconsistencies in implementations within schools and districts. The only exception was in the area of writing where student achievement was shown across the state (Lemke & Martin, 2003; Silvernail et al., 2011).

2.5.4 Pennsylvania's Classrooms for the Future.

Classrooms for the Future (CFF) was a $200 million, three-year project funded by the Pennsylvania Department of Education designed to increase students' technology literacy beginning in 2006 (Slamecka, 2011; Wagner, 2008). The goals for CFF were developed to: (a) enable teachers to use technology as an effective tool for education students; (b) prepare students to enter and successfully compete in the high-tech global marketplace; (c) improve teaching and learning in English, math, science, and social studies; (d) change student-teacher relationship; (e) increase student engagement; (f) increase student responsibility for learning; (g) develop 21st century skills; and (h) increase academic achievement. By 2009, over 12,000 teachers and 500,00 students had been impacted by the CFF initiative (Peck, Clausen, Vilberg, Meidl, & Murray, 2008).

Pennsylvania's CFF goal for moving instruction into the 21st century by transforming the classroom from teacher centered to learner centered is graphically represented. The graphical representation shows the new Blooms taxonomy on the left vertical axis to show complexity, with the bottom horizontal axis depicting teacher centered instruction to learner centered or constructivist teaching style. The diagonal axis represents the learning or activities in the classroom. The goal for CFF was to move classroom instruction to the top right quadrant of the chart shown in Figure 16 (Peck et al., 2008).

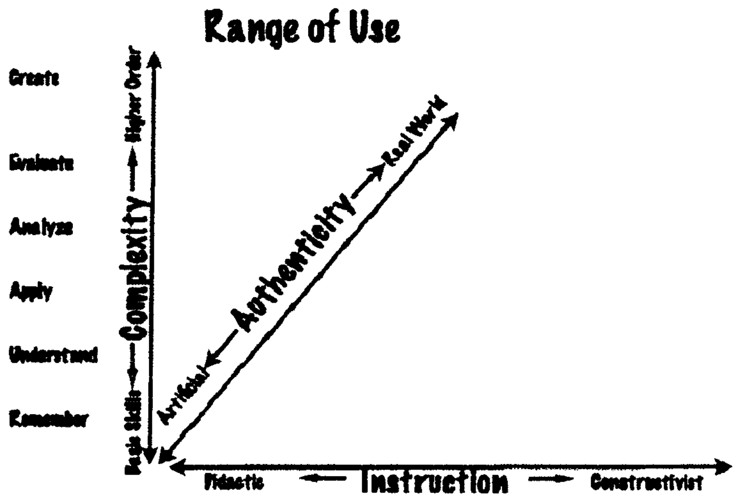


Figure 16. Pennsylvania CFF range of instructional use.

The Pennsylvania Department of Education partnered with Penn State's College of Education to form a core evaluation team made up of researchers from eight universities. Key findings in this statewide implementation of over 500,000 students reveal evidence of notable positive changes in the area of student and teacher activity, student engagement and classroom organization. Objectives set out by the Pennsylvania Department of Education to move classroom teaching to a more constructivist student-centered learning environment were met according to three years of evaluation by the research team (Peck et al., 2008).

2.5.5 North Carolina's One-to-One Learning Technology Initiative.

The North Carolina One-to-One Learning Initiative (NCLTI) was a public-private partnership between the North Carolina State Board of Education, North Carolina Public Instruction, Golden LEAF Foundation, and SAS with the goal to use technology to improve teaching practices; increase student achievement; and better prepare students for work, citizenship, and life in the 21st century (Corn, 2009). The Friday Institute for

Educational Innovation was contracted by the North Carolina Board of Education in spring 2008 to conduct a three-year evaluation of this one-to-one laptop initiative in 18 high schools, with approximately 9,500 students and 600 teachers where every student and teacher received a laptop with wireless internet access. The study analyzed comparative data between schools that implemented one-to-one laptops and those that did not with variables such as teachers' gender, race, ethnicity and level experience to be as similar as possible. Data was collected in recurring cycles from 2008 through 2010 in spring and fall with surveys administered to administrators, classroom teachers, and students. In addition, classroom observations, interviews, and focus groups were analyzed in this study (Argueta et al., 2011; Corn, 2009).

Key findings showed an increased impact on technology use, the role of the teachers, learning environment, and communication. Overall, teachers in the one-to-one laptop programs created learning environments where 21st century skills included technology/information literacy, understanding the global world, and group collaboration more often than their counterparts. While teachers generally provided positive statements regarding the one-to-one laptop initiative, many of them felt professional development was lacking (Argueta et al., 2011; Corn, 2009).

2.5.6 Michigan's Freedom to Learn.

Michigan's Freedom to Learn (FTL) one-to-one laptop program, funded through state and federal monies, provided laptops to approximately 22,000 students, 1,300 teachers, and 500 administrators and technology staff across middle schools primarily serving sixth grade students from high need school districts across Michigan. The program provided a complete solution to include laptop, curriculum, management, assessments, and professional development to increase student achievement and establish a 21st century workforce for Michigan (Ross & Strahl, 2005).

Ross & Strahl (2005) conducted a mixed methods evaluation using both SOM (Ross et al., 2006), and SCU (Lowther, Ross, & Morrison, 2001) in 12 random classrooms. In addition, interviews coupled with teacher and student surveys were administered to fifth, sixth, and seventh grade students who had 24/7 access to laptops compared to those students who were in a mobile laptop cart learning environment referred to as the control group in this study. The study was designed to determine the impact of laptops on the following: (a) classroom activities; (b) student use of technology in writing; and (c) to examine student problem solving skills (Lowther et al., 2003; Ross, Lowther, Wilson-Relyea, Wang, & Morrison, 2003).

Key findings indicate positive impacts for students using laptop computers as a learning tool. The study also revealed significant advantages for those students who had continuous, 24/7 access to laptops compared to those students in the control group who only had classroom access to laptops in a mobile cart environment. Teachers from both learning environments showed no significant difference in teaching activities; however, students from 24/7 access to laptop groups were engaged in more independent research activities than the control students with mobile cart laptops. Student use of computers in both environments showed no significant difference; however, 24/7 access to laptop student users had more advanced computer skills than their counterpart students in the control group. In the area of student achievement in writing, students who had access to laptops 24/7 outperformed students in mobile cart laptop environment in all three years of the study. Problem solving measurements revealed that 24/7 access to laptop student users outperformed students in the mobile cart group in all three years of the study in five of the seven problem-solving measurements (Ross et al., 2003).

2.5.7 Texas Immersion Pilot.

The Texas Education Agency (TEA) funded a $14 million project with federal and state funds to create a wireless learning environment for high-need, low-income middle schools as part of a competitive grant process to schools through the state of Texas. A non-profit research organization, the Texas Center for Educational Research (TCER) was a primary partner in providing an evaluation to test the effectiveness of this technology immersive project and its impact on increasing core academic test scores among middle school students across Texas. The project provided a complete solution with a laptop for every middle school student and teacher, wireless access across the school campus, online curriculum and assessments, professional development, and technical support (Shapley et al., 2006).

The research study used a quasi-experimental design with 22 middle schools assigned to a control group and 22 middle schools assigned to a treatment group. The Texas Assessment of Knowledge and Skills (TAKS) were used to measure the impact of immersion on student achievement in core subject areas. A mixed-methods design using observation and survey data collection tools, provided site visits in each middle school in the fall and spring of the 2003-2004 school year. Analysis of teachers' and students' self-reported perceptions of technology proficiency, coupled with students' TAKS achievement scores in the study and control groups used a two-level hierarchical linear model (HLM) to determine effects of immersion. Because this study was focused on high-need, low-income middle school populations in both control and study groups, results cannot be generalized across the broader Texas population.

Shapley et al., (2006) developed a theoretical framework for technology immersion to show the different inputs for the treatment and control groups, to the extent of the fidelity in which the components of this theoretical framework attained the vision for immersion. This model or framework assumed technology resources and supports that were provisioned in a school-wide initiative would produce technology adept teachers who use digital resources and laptops to transform teaching and learning. The study encompassed four school years from 2004-2008. This framework provided a guide for the evaluation team and provided a logic model for technology immersion leading to increased student academic achievement over this study period as shown in Figure 17 (Shapley et al., 2010; Shapley et al., 2006).

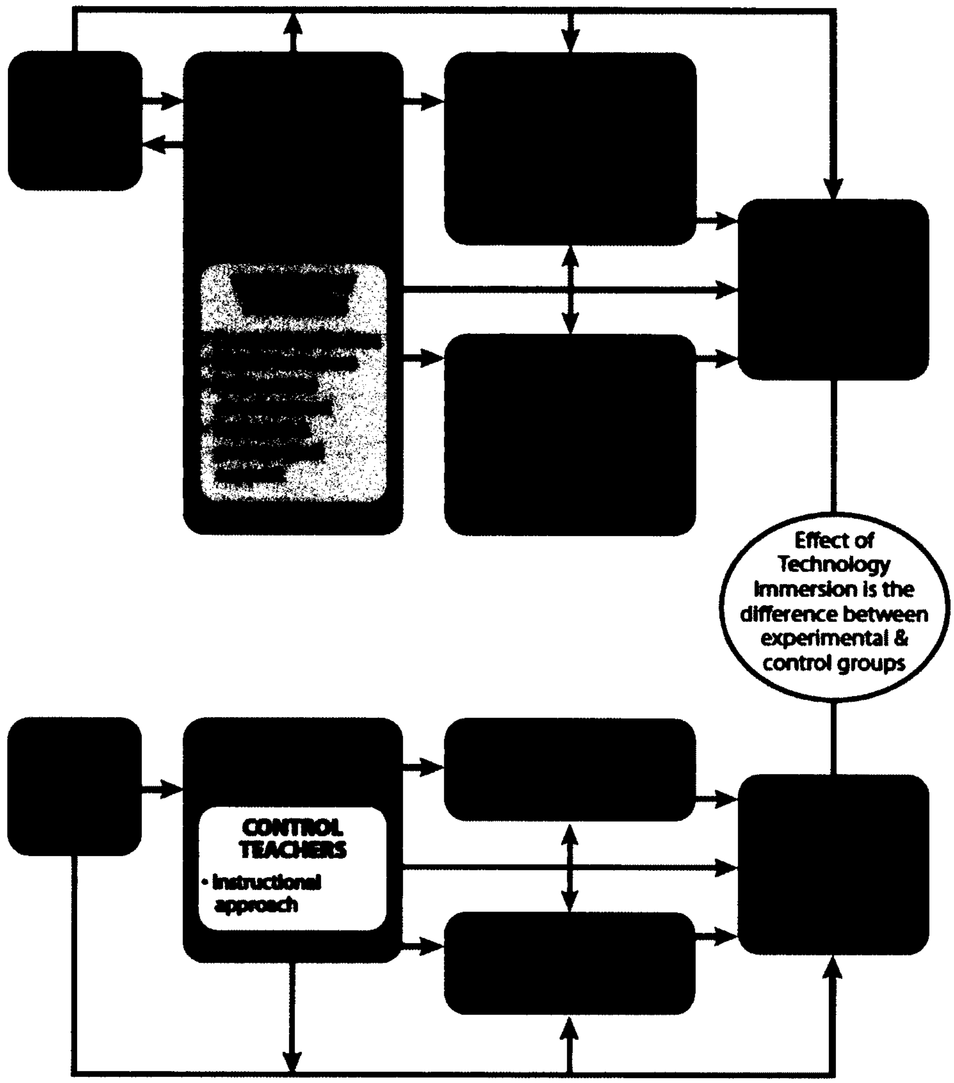


Figure 17. Theoretical framework for technology immersion.

Implementation indicators for technology immersion were captured in three areas including support, classroom immersion, and student access and use. Support was defined as technology immersion within leadership, teachers, parents, and community, technical, and professional development support. Classroom immersion captured the extent that core teachers use technology integration for learner-centered instruction, classroom activities, communication, and professional productivity. Student access and use measured laptop access, frequency of core subject learning with laptops, and home access (Shapley et al., 2010).

Key findings for academic achievement revealed that teacher-level predictors were not as strong as the level of Student Access and Use in predicting student reading achievement scores. Results showed that home learning as measured by the extension of the learning day with students' laptop use outside of school for core subject homework assignments or learning games was the greatest implementation predictor for reaching achievement and mathematics scores. Students who had access to digital resources and online textbooks on laptops were more motivated to work on assignments at home (Shapley et al., 2010).

2.5.8 Massachusetts' Berkshire Wireless Learning Initiative.

The Berkshire Wireless Learning Initiative (BWLI) was a three-year pilot program for one-to-one technology access for approximately 2,700 teachers and students across five public and private middle schools in Massachusetts implemented in 2005 (Bebell & Kay, 2009). The BWLI project was funded through a combination of state funds, district-level funds, and local businesses with the goal to transform teaching and learning in the middle school as measured by increased student achievement, student engagement, classroom management, student's capacity to conduct research, and peer collaboration, while creating a paradigm shift in teaching strategies and delivery of curriculum. The state of Massachusetts commonwealth funded a series of twelve quarterly reports to assess the BWLI with the Massachusetts Technology Collaborative (MTC) by Boston's College's Technology and Assessment Study Collaborative (inTASC) to measure the effectiveness of the program based on the goals stated above (Bebell & Kay, 2009). The evaluation team used a multi-year pre/post comparative design. Students and teachers who were part of the BWLI were designated by cohort groups and compared to students and teachers from neighboring middle schools without laptop access during the day that were designated as control groups.

Key findings in this three-year study were similar to other large-scale studies in that the implementation of one-to-one laptops, although varied among the five sites, produced positive results in English/Language Arts, but not math. Student engagement increased dramatically as depicted in classroom observations and interview data. The positive impacts of the BWLI program also included significant changes in classroom management, curriculum delivery and teaching strategies and showed enhanced student research and collaboration (Bebell & Kay, 2009; Bebell & Kay, 2010).

2.5.9 Summary of laptop initiatives and lessons learned.

Laptop implementations across the nation have varied results with some districts. Liverpool Central School District in New York, Matoaco High School in Virginia, Everett A. Rea Elementary School in Costa Mesa, California, and Northfield Mount Hermon School in Massachusetts all canceled their laptop program due to non performance, network issues, and cost (Hu, 2007). Warschauer (2006) also has found no evidence that laptops in the classroom increase student test scores; however, he does support laptop programs and feels that many of these schools may be giving up on technologies that have shown positive results in innovation, creativity, autonomy, and independent learning.

While most of the large-scale deployments of ubiquitous or one-to-one laptop initiatives varied in goals, there was a growing consensus regarding implementation for a comprehensive, successful program. Lessons learned from implementations of one-to-one laptops have three common themes for success and include the following: (a) teachers play a critical role in effective implementations, (b) school level leadership to support one-to-one laptop initiatives is key in developing consistent administrative policy, conditions for ubiquitous computing, and (c) on-going professional development was important to the success (Bebell & Kay, 2010; Penuel, 2006; Shapley et al., 2010; Warschauer & Matuchniak, 2010; Zucker, 2005).

2.6 Technology to Extend the Learning Day

Home access or the role of computers in the home has had very little attention in the literature to-date. One-to-one laptops have provided a ubiquitous environment in the classroom and have the potential to provide equity for home access due to device mobility (Beltran, Das, & Fairlie, 2006). Further studies have shown positive outcomes for keeping students in school, reducing crime, and ultimately providing a higher likelihood for graduating from high school, even when the technology in the classroom is not effective (Cuban et al., 2001; Peck et al., 2008).

Instructional resources made available for students to use with laptops at home, provide opportunities for students to extend their learning day (Wallace, 2004). Students who have access to rich instructional resources beyond the school day are provided additional opportunities for "time on task" as identified by Carroll's "Model for Learning" (Carroll, 1963). Carroll ascertains that school learning or academic achievement is directly influenced by time spent on the task and time needed for the task. Six elements defining learning as a function of effort needed for academic achievement are shown in Figure 18 (Carroll, 1963).

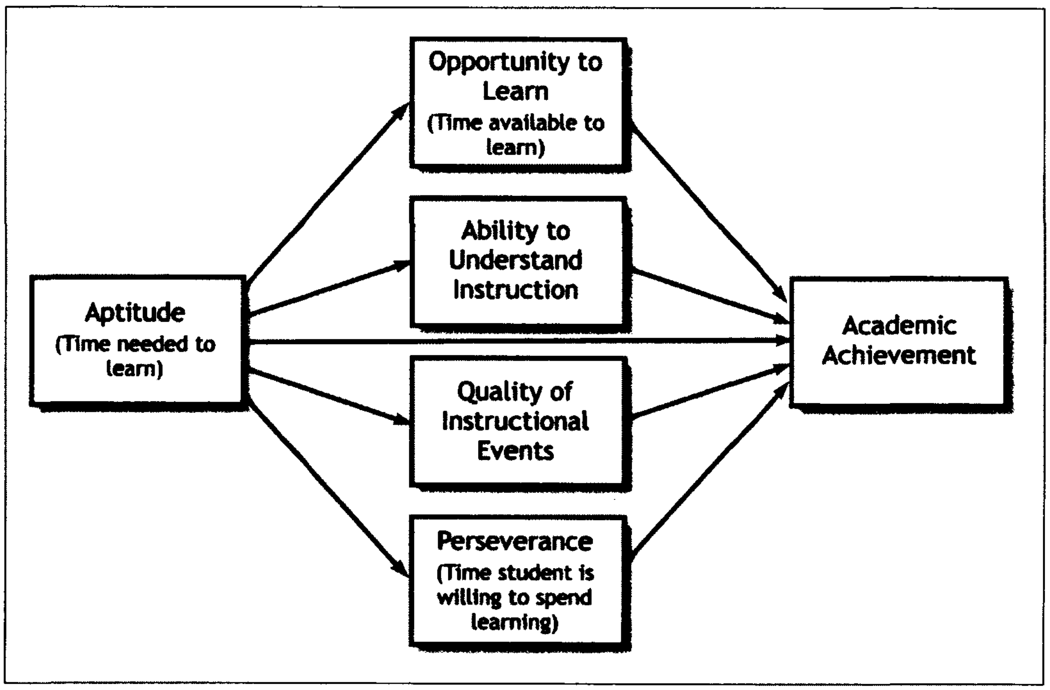


Figure 18. Carroll's model of school learning.

Carroll's (1963, 1989) model for learning focused on standardized tests, grades achieved in academic coursework, grade-point-average (GPA), high school completion rates and graduation rates from college as a measurement for academic achievement. He viewed the most influential variable to be "the amount of time a student needs to learn a given task, unit of instruction, or curriculum to an acceptable criteria of mastery under optimal conditions of instruction and student motivation" (Carroll, 1989, p. 27). In addition to time on task, Carroll sought to recognize that the factor of motivation for the student was portrayed in the amount of time a student was willing to spend on learning a given task. School learning in a particular subject, was defined by Carroll, as time spent learning in that subject area, divided by the time needed to learn the subject matter as shown in Figure 19 (Carroll, 1963).

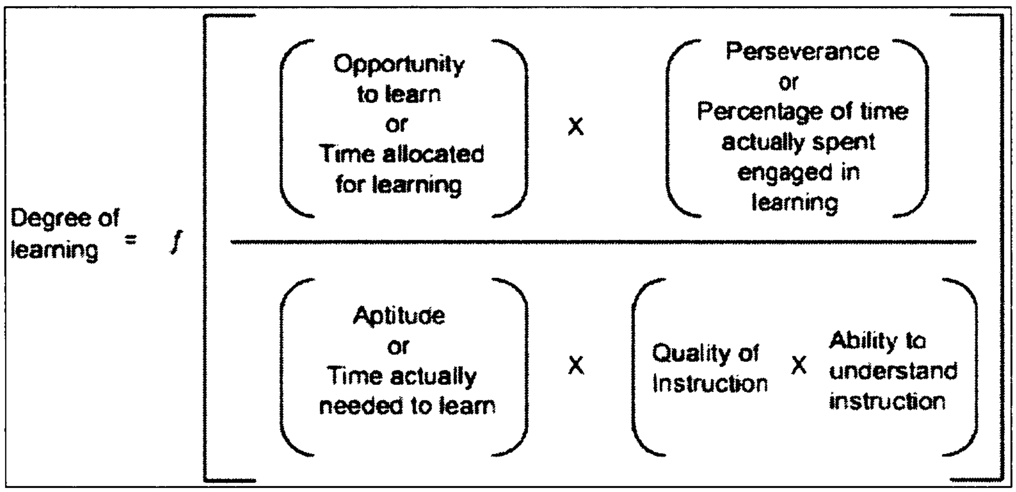


Figure 19. Carroll's degree of learning.

Carroll (1989) contended that if students had similar aptitude in time needed to complete a task, then if any of them who put forth more effort (i.e. more time spent on the task), would attain higher achievement. This model supports the goals to extend the learning day for one-to-one laptop programs.

Reeves (2007) expanded on Carroll's model for learning to broaden the model's scope to include the world-wide-web (WWW) for instructional resources. These resources included: (a) enriching access to course materials; (b) documenting course discussions; (c) posting student writing, art projects, etc. for critique; (d) providing tutorials, simulations, and drills; (e) facilitating group work; (f) providing remedial support and/or enrichment; and (g) enabling reflection and metacognition. All of these online instructional resources provide for opportunities to extend the learning day, providing additional time on task for students. Students in one-to-one laptop classrooms where teachers create online instructional materials may be afforded the additional time for learning when given online instructional resources to extend the learning day. This access to information via the world-wide-web can provide students with the opportunity to learn, especially when teachers are providing curriculum materials and instructional resources; however, these resources may not be available for students in communities where broadband is not available (Reeves, 2007).

2.6.1 Home computer access and student achievement.

Experimental and quasi-experimental studies have shown varied results in studying the impact of computers for instruction with home use (Clotfelter, Ladd, & Vigdor, 2008). Attewell and Battle (1999) shared results to show positive test scores and grades in relationship to home computer use within varied demographic groups. Schmitt and Wadsworth (2004) study using the British Household Panel Survey showed significant gains on British school exams in association with home computers. In contrast, Fuchs and Woessmann (2004) reported a negative relationship between student achievement with significantly lower scores in math and reading among British students with home computers using the International Programme for International Student Achievement data and suggested that the home computer was a distraction to learning.

One-to-one laptop initiatives have been partially motivated by this research, and at the same time, have been seen as solution for the inequity in access to computers at home. A study in North Carolina public schools expanded on the previous studies with a larger sample size and the use of longitudinal data to show differences in home access and high speed internet access (Clotfelter et al., 2008). The longitudinal nature allowed the researchers to compare test scores of students before and after computer and internet access. Clotfelter et al., (2008) replicated studies from other researchers and found positive associations between home access and student achievement; however students who had access to a home computer between 5th and 8th grades showed declines in reading and math scores depending on productivity and monitoring in the home, and recommended policymakers to rethink the investment of one-to-one laptops for home use as they would be counterproductive to student achievement.

Findings in the study demonstrated that the introduction of high speed internet access along with home computer access across North Carolina was associated with a modest, yet statistically significant negative impact on student reading and math test scores (Vigdor & Ladd, 2010). In contrast, Shapley et al., (2010) showed promising results for reading and math scores when students used their laptops for home learning, and that home access was the strongest predictor of higher student test scores in reading and mathematics. These reports fueled the debate as to whether the investment of billions of dollars in one-to-one laptop programs is a wise decision. The argument that studies of computer access in the home that have provided promising correlations have not used reliable research designs has been cited by many researchers (Attewell, Suazo-Garcia, & Battle, 2003; Beltran et al., 2006; Vigdor & Ladd, 2010). The authors state that one of the key factors that may be missing from these studies is the parent oversight of how the internet and home computers are being used. Scholars and researchers on the contrasting camp, believe that closing the digital divide in access to the internet and home computers has a positive economic and social impact (Kvasny & Keil, 2006; Warschauer et al., 2002).

Learning is no longer contained within the school walls during school hours; instead, learning extends beyond the classroom and into the home environment (M. G. Robinson, 2007). M.G. Robinson's study focused on the relationship between home information and communication technology access, and sought to determine if socioeconomic status contributed to successful learning opportunities. M.G. Robinson (2007) focused on the implications of barriers to connectivity, which she defined as access to information and communication technology. Her study answered the question as to whether the widening of the digital divide gap in the home would further limit the education opportunities for students. The findings from M.G. Robinson's (2007) study revealed a strong relationship between socioeconomic status and home computer access.

Findings from numerous studies provide correlations between home use of computers and student achievement. In 2002, a study conducted by Tsikalas and Gross (2002) studied the impact of home use of computer by 89 adolescent students from low-income families and their seven teachers. Findings revealed positive gains in student achievement, parent involvement through communication, students feeling more confident, and increases in class participation. Beltran et al., (2006) study revealed that students who had home computers had higher graduation rates than those students that did not. In addition, findings by Attewell and Battle (1999) revealed higher test scores in mathematics and reading in association with home computer access. In a longitudinal study conducted by Du, Harvard, Yu & Adams, (2004) findings revealed benefits for students having a home computer and how they learned with technology in school, noting that disadvantaged students often used technologies at school for drill-and-practice activities, compared to higher SES students using technology for higher-order thinking activities. According to Fairlie (2004) nine out of ten students who have access to a home computer use it to complete schoolwork, and found a positive association in school enrollment among teenage adolescents and home computer access.

2.7 Literature Review Summary

This chapter provides understanding and background in the research on the important social inequalities represented by the digital divide. The digital divide should not simply be referenced as a have and have-not statistical analysis spread across a demographic population. There are real social implications within the digital divide not only for the education system, but the economic prosperity of the U.S.

Large-scale one-to-one laptop implementations provide not only a research base; they also fostered the development of frameworks for future studies. While key findings vary across these studies, there have been common positive results for student achievement in a one-to-one laptop learning environments. Extending the learning day with the use of laptops and connectivity to the internet, coupled with teacher created online learning resources showed positive results in several studies. Finally, the review of literature presented provides an understanding of the many facets that are necessary to create a successful learning environment in the 21st century.

Chapter 3: Methodology

This research is a descriptive, comparative inquiry that reviewed the implementation of one-to-one laptops in high schools across 39 schools in Alaska communities, focusing on the specific goal for the laptop project to extend the learning day for students. The research for this geographically diverse study focused on high schools in Alaska that implemented a one-to-one laptop program, and met the defined criteria identified in section 3.4.1.

The purpose of this concurrent mixed methods study is to identify Student Personal Use (SPU) Levels of Adoption (LoA), Student Classroom Use (SCU) LoA, Teacher Personal Use (TPU) LoA, and Teacher Classroom Use (TCU) LoA, across three categories of community broadband availability. Specifically, this study sought to show if there was a difference in LoA in personal use, and classroom use, for teachers and students who live in communities with no broadband access available in the home, compared to student and teacher classroom and personal use LoA who live in communities with broadband availability. Community broadband availability was captured through local community Internet Service Providers (ISP), and validated with follow-up emails to administrators and teachers who lived in the communities in the population study (Appendix B). Three categories used for school community broadband included: (a) terrestrial community broadband; (b) satellite community broadband; and (c) no community broadband. The FCC classifies broadband as having minimum speeds of 786k download and 200k upload (Federal Communication Commission, 2010). The distribution of community broadband availability is in Appendix B.

Concurrently, qualitative data was gathered to complement the quantitative data through open-ended questions in both the teacher and student surveys. Themes were compared across the three categories of bandwidth availability in the home. In addition, student focus groups were conducted in four of the schools in the study population. Qualitative data was used to gain understanding of the perceptions of students regarding internet access availability and LoA, as defined by the survey instruments for their home use of laptops. Using a mixed methods approach is meant to complement the strengths and any weaknesses of the data and provide multiple forms of data to corroborate findings and expand the understanding of the researcher (Creswell, 2009; Johnson & Onwuegbuzie, 2004).

Chapter three outlines the methodology for this study in the following sections: Research Questions, Theoretical Lens and Research Design, Context of the Researcher, Population Parameters and Delimitation of the Study, Survey Instrument Development and Administration, Analysis of Quantitative Data, Analysis of Qualitative Data, Triangulation of Data Summary.

3.1 Research Questions

The overarching research question providing the foundation for this study is "Does broadband availability in a school community have an impact on the teaching and learning experience for teachers and students in one-to-one laptop programs?" There are nine investigative questions with supporting hypotheses that support the main research question in this study

3.1.1 Investigative questions and hypotheses.

Descriptive statistics using frequency to show distribution of data was used to capture demographic information within each of the three community broadband availability categories and comprised of six demographic characteristics for students including, (a) age; (b) gender; (c) ethnicity; (d) years in current school; (e) years participating in one-to-one laptop program; and (f) perceived level of technology proficiency. Teacher population across the three community broadband availability categories is comprised of eight demographic characteristics including, (a) age; (b) gender; (c) ethnicity; (d) tenure at school; (e) teaching tenure; (f) years taught in one-to-one laptop program; (g) professional development; and (h) perceived level of technology proficiency.

3.1.2 Student perceptions and use.

- Research Question 1: Does access to broadband in the home make a difference in the amount of time spent by students using the laptop for home use?
    1. Null Hypothesis H_0: There is no difference in the amount of time spent using laptop for home use, given three categories of community broadband availability.
    2. Alternate Hypothesis H_1: There is a difference in the amount of time spent using laptop for home use, given three categories of community broadband availability.
- Research Question 2: Does access to broadband in the home make a difference in the amount of time spent by students on the laptop for schoolwork?
    1. Null Hypothesis H_0: There is no difference in the amount of time spent using laptop for schoolwork, given three categories of community broadband availability.
    2. Alternate Hypothesis H_1: There is a difference in the amount of time spent using laptop for schoolwork, given three categories of community broadband availability.
- Research Question 3: Does access to broadband in the home make a difference in SPU LoA?
    1. Null Hypothesis H_0: There is no difference in SPU LoA, given three categories of community broadband availability.
    2. Alternate Hypothesis H_1: There is a difference in SPU LoA, given three categories of community broadband availability.
- Research Question 4: Does access to broadband in the home make a difference in SCU LoA?
    1. Null Hypothesis H_0: There is no difference in SCU LoA, given three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in SCU LoA, given three categories of community broadband availability.

- Research Question 5: Does access to broadband in the home make a difference as to whether teachers assign homework that requires internet access at home?

  1. Null Hypothesis H_0: There is no difference as to whether teachers assign homework that requires internet access at home, given three categories of community broadband availability.

  2. Alternate Hypothesis H_1: There is a difference as to whether teachers assign homework that requires internet access at home, given three categories of community broadband availability.

3.1.3 Teacher perceptions and use.

- Research Question 6: Does access to broadband in the home make a difference in the amount of time spent by teachers using the laptop for home use?

  1. Null Hypothesis H_0: There is no difference in the amount of time spent using laptop for home use, given three categories of community broadband availability.

  2. Alternate Hypothesis H_1: There is a difference in the amount of time spent using laptop for home use, given three categories of community broadband availability.

- Research Question 7: Does access to broadband in the home make a difference in TPU LoA?

  1. Null Hypothesis H_0: There is no difference in TPU LoA, given three categories of community broadband availability.

  2. Alternate Hypothesis H_1: There is a difference in TPU LoA, given three categories of community broadband availability.

- Research Question 8: Does access to broadband in the home make a difference in TCU LoA?

1. Null Hypothesis H_0: There is no difference in TCU LoA, given three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in TCU LoA, given three categories of community broadband availability.

- Research Question 9: Does access to broadband in the home make a difference as to whether teachers create online learning resources for students to extend the learning day requiring internet access at home?

1. Null Hypothesis H_0: There is no difference as to whether teachers create online learning resources for students to extend the learning day requiring internet access at home, given three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference as to whether teachers create online learning resources for students to extend the learning day requiring internet access at home, given three categories of community broadband availability.

3.2 Theoretical Lens and Research Design

Creswell identifies four philosophical worldviews that "influence the practice of research" (Creswell, 2009, p. 5). These philosophical worldviews guide the researcher to the selection of a research design, methods, and strategies of inquiry (Creswell, 2009). Worldviews, also known as paradigms identified by Creswell include Postpositivism, whereas the researcher believes there is a need to identify the causes that influence the outcomes. Postpositivists use more traditional research strategies, including the scientific method, begin with a theory, and then collect data to either refute or support the study. The second worldview identified by Creswell is the Social Constructivism, whereas the researcher seeks to understand the world in which they live, generally using more qualitative methods to gather data through personal interactions. The third worldview identified by Creswell is the Advocacy/Participatory approach, where the researcher addresses an important social issue focusing on the needs of groups and individuals in our society that have been either marginalized or disenfranchised. The fourth worldview identified by Creswell is that of that of Pragmatism, evolving from the need for the researcher to understand the problem (Creswell, 2009).

The worldview lens, or paradigm, for this study is that of advocacy/participatory. A mixed methods approach created the framework for this study to understand the digital divide for students and teachers in one-to-one laptop programs across Alaska. The ultimate goal for any research project is to answer the questions set forth in the study (Creswell, 2009; Morse, 2003). The research design for this non-experimental mixed methods study incorporates a concurrent embedded design with the quantitative primary method being use of surveys administered to students and teachers, and a qualitative secondary method being use of open-ended questions and student focus groups conducted in four of the schools. The concurrent embedded design for this research study is shown in Figure 20 (Creswell, 2009).

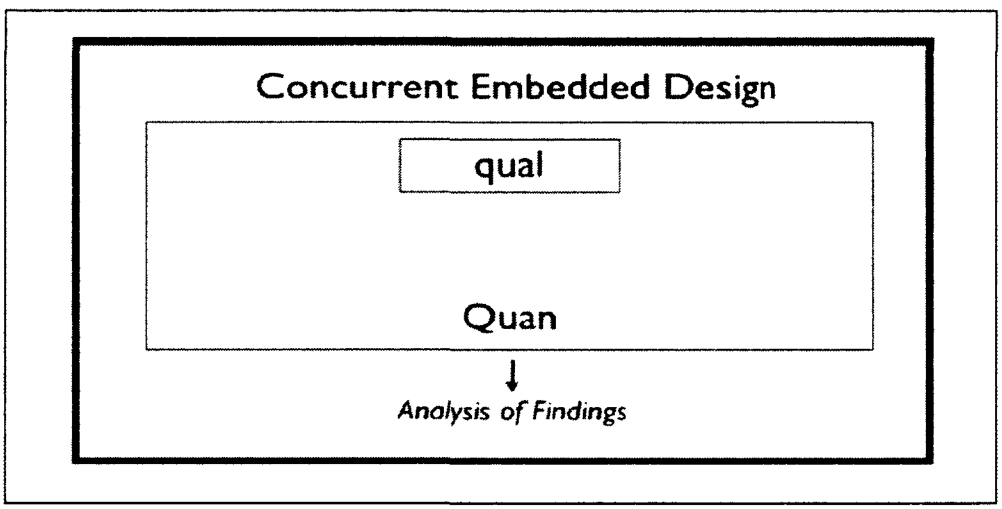


Figure 20. Creswell's concurrent embedded design.

This research design approach provides the researcher a broader perspective, as well as clarification, of the results from quantitative and qualitative data, in that each method complements the strengths of the other (Gall, Gall, & Borg, 2007; Greene, Caracelli, & Graham, 1989; Johnson & Onwuegbuzie, 2004). The data from both methods was then integrated together to answer the research questions for this study.

3.3 Context of the Researcher

The context of the researcher is important to this study to understand bias and credibility (Sandoval & Bell, 2004). The researcher's background in education, coupled with her current position in the K-12 division of a large, Alaskan-based telecommunications company, provides the context and reasons for this study. As an educator, working in the telecommunications business of providing internet access and distance learning services to over 100 schools, she has had the privilege to visit many of the schools that make up the population for this study. She has witnessed and heard stories about students going back to school, after hours, and sitting on the metal grated steps of the school building to get close enough to the wireless access point to get online. These stories and experiences provided a strong sense of responsibility to address the inequities among the population of students and teachers who live in areas of rural Alaska where broadband access is not available.

3.4 Population Parameters and Delimitation of the Study

3.4.1 Parameters of research population.

In 2006 and 2008, the Association of Alaska School Boards' Consortium for Digital Learning (AASB-CDL) was awarded legislative funds used to fund one-to-one laptop programs through a grant/match program to schools across Alaska. By the end of 2008, over 100 schools had implemented one-to-one laptop programs across all grade levels, with the majority of these implementations in rural Alaska high schools. The AASB-CDL modeled the one-to-one program implemented in Alaska using the research of other large-scale one-to-one laptop initiatives in Maine and Virginia. The model used for one-to-one laptops in Alaska incorporated recommendations to provide a "complete solution" for implementation. This solution based on recommendations from Apple, Incorporated, required school districts to adhere to defined requirements to receive a two-thirds grant match from AASB-CDL program, coupled with one-third match in district funding. This provided the funding solution for a one-to-one laptop program in Alaska's schools. The defined requirements for a complete solution included five necessary components: (a) wireless network infrastructure had to be in place in the school for laptops to use internet and local area network (LAN) resources; (b) a common hardware platform and a common software package with both productivity and creativity software; (c) a prescribed package of professional development for both teachers and technical staff; (d) the development of an in-state repair depot for a quick turn around for damaged equipment; and (e) laptops would be available for students and teachers to use at home for 24/7 learning opportunities. This "complete solution" became the common definition for identifying the program population for high school students and teachers in this study.

3.4.2 Delimitation of population sample.

Participating high schools were selected based on those schools identified by the cohort as having implemented a one-to-one laptop program for at least one year, with a complete solution defined by the AASB-CDL in section 3.4.1 (Association of Alaska School Boards, 2006). All of the participating school districts have provided the required permission as outlined in the Institutional Review Board approval in Appendix D.

The program population used for this study is derived from the original 28 school districts that were identified in the AASB-CDL project. Six districts did not have implementations at the high school level and were omitted from the program population. They included, Alaska Gateway, Fairbanks, Kenai, Ketchikan, Kodiak, and Valdez. Two districts, Anchorage and Copper River, were omitted, as they didn't meet the requirements for taking laptops home. In addition to the AASB-CDL identified school districts with one-to-one laptop implementations, the cohort worked with school personnel outside of the AASB-CDL initiative to determine additional school districts that met the requirements for a "complete solution". Two districts that were not on the AASB-CDL project were added to the program population. The final program population included 22 districts. Permission was received from 15 of the 22 districts; however, not every district had participating schools. The actual study population was decreased to 13 districts, or 39 communities, that provided response to surveys administered. Two of the districts where permission was secured to administer the surveys were not able to participate due to end of year commitments. Teachers (n=367), and students (n=2,639), provided the total program population used for the basis of identifying the one-to-one laptop program population. Student numbers were determined by the Alaska Department of Education and Early Development enrollment for school year 2010-2011 (Alaska Department of Education and Early Development, 2010). Teacher calculations were determined by numbers of teachers reported on the Alaska Department of Education and Early Development's School Report Cards, individual school websites, and emails to administrators in the district.

Current results of the survey show that 796 students attempted the survey with 732 or (92%) of the students completing the survey. The teacher survey results show that 121 teachers attempted the survey, with 79.3% (n=96) of the teachers completing the survey. Respondents were omitted due to critical data missing, and non-responsiveness to the survey. After cleaning the data a second time, 7 students were omitted due to unreliable data with the same response across the entire survey. Two additional teachers were omitted due to criteria missing for requirements in teaching in a one-to-one laptop classroom (i.e. administrators who did not teach).

3.4.3 Response rate.

Final total responses used in this study were analyzed with 725 students responding to the student survey and 94 teachers responding to the teacher survey. Response rate is defined as "the percentage of the potential respondents who were initially contacted and completed the questionnaire" (Rea & Parker, 2005, p. 143). Respondents from 39 schools in 13 districts returned surveys with a total response rate of 40% (n=94) for teachers and 43% (n=725) for students.

The surveys contained both proportional and interval scale variables. According to Rea & Parker (2005) it is important that the researcher determine the sample size by using a mix of proportional and interval variables to select a sample size with an overall margin of error and level of confidence/ The survey instrument used both proportional and interval scale variables. Using calculations suggested by Rea & Parker (2005) for a teacher study population of 94 teacher respondents, there was a 95% confidence level, with a +/- 8% margin of error. The student study population with 795 respondents resulted in a 95% confidence level, with a +/- 3% margin of error.

The actual study population was based on 13 districts that administered the surveys. These surveys were returned with a response rate of 40% for teachers (n=94) responses and a response rate of 43% for students (n=725) responses. The 13 districts make up the total study population with (n=1,691) students and (n=236 teachers) as shown in Table 2.

Table 2

Program/Study Population Response Rate

Survey Instrument	Alaska One-to-One Program Population	Alaska One-to-One Study Population	Valid Responses	Response Rate
Teacher	366	236	94	40%
Student	2,639	1,691	725	43%

3.4.4 Questionnaire design and administration.

The methods for data collection for this study used a separate online cross-sectional quantitative survey instrument for teachers and students as the predominant method. Secondarily, a qualitative analysis using nine open-ended questions at the end of the teacher survey and three open-ended questions at the end of the student survey was used to support and complement the findings from the quantitative surveys. Each cohort member contributed a question to the focus group questions administered to five of the schools participating in the study. The online surveys were administered using Surveymonkey.com.

3.4.5 Web-based survey development.

The twenty-first century has created positive environments through technological advances to revolutionize the way researchers use evaluation instruments. The advent of the world-wide-web has allowed for researchers to administer on-line surveys. The ability to offer the survey instruments on-line to participants spread across Alaska, offered flexibility for both the researcher and the teachers and students participating in the study (Evans & Mathur, 2005).

The cohort used evaluation instruments from previous studies, with permission from original authors. Survey instruments were created for both teachers and students to include demographic information and survey questions, as well as professional development, teaching style, bandwidth levels, use beyond the school day, and perceptions of students and teachers in use of technology both in school and at home. Three of the cohort members used the teacher survey, and two of the four cohort members used the student survey. The fourth cohort member conducted qualitative research using focus groups. Both surveys were administered in late spring of 2011 to provide a full school year of laptop use in the classroom and home.

Both of the survey instrument tools used a five-point, Likert-like scale in the section of the survey reporting levels of use, as well as self-perceived attitudes and beliefs in personal, professional, classroom, and student use of technology tools. Both the teacher and student survey instruments were based on existing surveys. The quantitative portion of the teacher survey instrument tool contained questions from several models including the Concerns Based Adoption Model (CBAM), (Hall, George, & Rutherford, 1977), the Apple Classrooms of Tomorrow's (ACOT) Evolution of Thought and Practice (ETP), (Dwyer, Ringstaff, & Sandholtz, 1991); the SAMR Technology Adoption Cycle (Puentedura, 2006); and Rogers' Diffusion and Innovation (Rogers, 2003). In addition, questions from the Metiri group survey instrument, that was administered for the Consortium of School Networking Leadership Initiative with results reported on the CoSN website (Lemke, Coughlin, Garcia, Reifsneider, & Baas, 2009) were used in the teacher and student surveys. Permission was obtained by Lemke to use questions referencing personal use, classroom use, and professional practice for our surveys. The cohort discussed the documentation for the design of the survey questions, including the weighting and scoring of the survey instrument with Lemke. The survey instrument created by the cohort also included questions from a dissertation study (Dalgarno, 2009) used to measure teacher beliefs and attitudes of technology use. This survey was modified for cultural relevance for schools in Alaska. The last section of the teacher survey instrument investigated teachers' perceptions of their teaching style and philosophy using questions from a national study "Teaching, Learning, and Computing: 1988," (Anderson & Becker, 2001). Permission was secured from the researcher prior to use in the cohort Teacher Survey. The last page of the survey tool allowed for open-ended responses.

3.4.6 Levels of Adoption (LoA).

Lemke (2009) Personal Technology Profile (PTP) established a protocol to create indices by combining proficiency and frequency of use questions for both students and teachers. Two categories for teachers technology use included Teacher Personal Use (TPU), and Teacher Classroom Use (TCU), with the same two categories used for students including, Student Personal Use (SPU), and Student Classroom Use (SCU). Each of these sections included questions using a 5-point Likert scale, identifying frequency of application use with response choices of (never, rarely, occasionally, fairly often, and very often); situational questions with response choices of (not like me, a little like me, somewhat like me, a lot like me, exactly like me); and perceived expertise (proficiency) questions with response choices of (no expertise, novice, intermediate, expert, and advanced). Responses in frequency and proficiency were weighted using Lemke's study scoring guide. Scoring was based on the complexity of the technology use as well as the timeline for specific technologies existing within three rankings of low (1, 3, 5, 6, 7); moderate (1, 4, 6, 8, 10); and high (1, 5, 8, 10, 12).

The modification to Lemke's PTP was necessary in order to create a total index of use within TPU, TCU, SPU, and SCU. Modifications made in this study provided the means to develop an index in each category of personal and classroom use. The original intent in Lemke's PTP was to provide a personal profile within defined roles within a non-equidistant range for reporting. The modification made for this study allowed for the total index to include frequency of use and expertise/proficiency questions, to be combined to create Levels of Adoption (LoA).

LoA were developed for both teacher and student survey analyses. Each category of TPU and TCU within the teacher survey, and SPU and SCU within the student survey created an overall index percentage, using the weighting and complexity identified by the Lemke survey scoring guide. The total index for each of these categories was broken down into Levels of Adoption based on the total percentage scored by each participant.

For the purpose of this study, the total index percentages were divided into four level ranges as shown in Table 3.

Table 3

Levels of Adoption (LoA) Range for Total Index

Levels of Adoption	Percentages
Level 1 Adoption	0.0%-24.99%
Level 2 Adoption	25.0-49.99%
Level 3 Adoption	50.0-74.99%
Level 4 Adoption	75.0-100.0%

3.4.7 Teacher survey.

The teacher survey instrument was created using the frameworks identified above, and included a 215 closed-item questionnaire with nine open-ended questions. These surveys were disseminated to high school teachers and students in 39 schools across Alaska. The teacher survey included an informed consent statement as part of the online survey. The teacher survey comprised of the following six sections:

- Section one: demographic questions made up of 10 questions and 11 items. Questions included, (a) school district; (b) school; (c) gender; (d) age; (e) ethnicity; (f) tenure teaching; (g) tenure teaching in the state; (h) tenure at current school; (i) tenure teaching in a one-to-one laptop program; and (j) perception of level of proficiency.
- Section two: internet access made up of eight questions and eight items. Questions included, (a) district provided laptop for home use; (b) perception of students' having internet access at home; (c) perception of students using the internet for school work; (d) teacher created online lessons and resources for students to use at home; (e) option for internet access at home; (f) bandwidth speed; (g) hours spent per day on home internet; and (h) hours spent on home internet for school-related tasks.
- Section three: professional development questions made up of six questions, 58 items. Questions included, (a) professional development provided by district; (b) number of professional development hours provided by district;

(c) number of hours spent outside of school time on professional development; (d) frequency in using web tools for professional practice; (e) levels of professional use of technology; and (f) perceived level of expertise using varied learning approaches.

- Section four: personal practice, made up of two questions, 25 items. Questions included (a) frequency of personal use of web tools; and (b) technologies, and perceived levels of personal use.
- Section five: Classroom use, made up of seven questions, 68 items. Questions included, (a) perceived technologies students use in teachers' classroom; (b) overall use of laptops in classroom; (c) perceived change in lessons using laptops; (d) concerns about laptop program; (e) frequency of laptop use in classroom; (f) types of concerns about laptops in classroom; and (g) perceptions of critical components necessary for one-to-one laptops in classroom

3.4.8 Student survey.

The student survey instrument was created using adaptations from the teacher survey with like questions and included a 100 closed-item questionnaire and three open-ended questions in order to provide for congruence in response patterns for data analysis. The demographic section in the student survey mirrored the teacher survey. Modifications were made after the pilot to provide relevant reading level and word choice based on feedback from teachers where wording was confusing and/or not appropriate for the grade level. Similar to the teacher survey, open-ended questions were included in the student survey. The student survey included an informed consent statement as part of the online survey. The student survey was comprised of four sections including:

- Section one: demographic questions, made up of nine questions, and nine items. Questions included, (a) school; (b) school district; (c) gender; (d) grade level; (e) age; (f) ethnicity; (g) number of years at current school; (h) number of years with a school-issued laptop; and (i) perceived level of technology user.

- Section two: internet access, comprised of nine questions and nine items. Questions included, (a) home use of laptop; (b) personally owned computer at home; (c) uses of laptop at home; (d) internet access type; (e) bandwidth speed; (f) perception of home internet making him/her a better student; (g) hours per day spent on internet at home; (h) hours spent per day on internet at home for school work; and (i) teacher provides homework that requires internet at home.
- Section three: Personal use of technology, made up of two questions, and 35 items. Questions included, (a) frequency of web tools and technologies for personal use; and (b) perceived levels of personal use.
- Section four: School or classroom use of technology, made up of three questions, and 41 items. Questions included, (a) frequency of learning strategies used in classroom; (b) school filter parameters; and (c) use of laptops in school subjects.

3.4.9 Expert review of the questionnaire.

Because the survey instruments for both teachers and students were constructed using three of the four cohort members' questions, it was necessary for the cohort to work together in securing experts to review both instruments. The cohort used a variety of experts in the field of technology to review the construct of the survey instrument, including Metiri Group and Apple, Incorporated. On more than one occasion, cohort members met with Cheryl Lemke, the author of the PTP survey instrument. The use of experts in the field to guide the development of the survey instruments provided the necessary quality review.

In addition, the cohort met with the Alaska Department of Education and Early Development Technology Coordinator via teleconference to discuss the roles of technology use among students and teachers. The cohort received expert advice and opinions from technology directors, teachers, and state leaders in the creation and use of open-ended questions for the teacher and student surveys.

3.4.10 Pilot study.

The cohort developed teacher and student survey was submitted to the Institutional Review Board in the fall semester of 2010. A comprehensive pilot study was conducted with both teachers and students in two schools to analyze validity and reliability of the survey instrument.

The surveys were administered to teachers and students as a pilot in Kiana High School in the Northwest Arctic Borough School District on January 21, 2011 in Kiana, Alaska. The entire high school population, including 26 students and four teachers participated in the pilot. Mark Standley, a cohort member, met with teachers and students and assisted in the administration of the surveys. Standley captured approximately 20 minutes of inputs and recommendations from the four teachers. These recommendations were used to make revisions to the survey instruments.

The second pilot was held in Quinhagok, Alaska on March 17, 2011, at the Kuinerrarmiut Elitnarurviat School in the Lower Kuskokwim School District, and was administered by Erin Cavanaugh, a technology teacher expert working in the District. The entire high school population including 20 high school students and three teachers participated in this second pilot. Feedback from Cavanaugh and Standley was incorporated into the final survey instrument on April 14, 2011.

Based on the two pilots, the following feedback recommendations were implemented in the new survey included: (a) both teacher and student surveys were shortened and reorganized into topical areas; (b) logic was implemented to skip sections of the survey where appropriate; (c) questions were consolidated into charts to create page view instead of split pages; (d) each question was marked as required response to lessen the need for cleaning up messy or incomplete data; (e) both student and teacher surveys were modified to align nomenclature and readability; (f) Surveymonkey tool/license was updated to allow advanced downloads for SPSS; (g) percent complete was added to show participants status in the length of the survey; and (h) internal Surveymonkey rewards were built into the survey tool.

3.4.11 Validity and reliability.

Reliability is the consistency of measurement, using either a test/retest method or using internal consistency within questions on the survey tool (Creswell, 2009). Validity is the strength of the conclusions, inferences, or propositions (Cook & Campbell, 1979).

Both the student and the teacher survey used internal consistency within the survey tools using established surveys and survey questions between the teacher and student survey instruments. In addition, analysis using Chronbach Alpha, to show internal consistency among items in the completed survey, was conducted using pilot data.

Validity within the study was secured in several ways. First, the cohort reviewed outside expert perspectives to design the survey instrument. These outside experts coupled with pilot study participants influenced changes in the design for the final survey instrument tool. Secondly, the cohort interviewed a well-informed expert in the field of education technology regarding themed questions based on the survey questions. These coded themes were matched against the questions and responses from the administered surveys. Lastly, the cohort relied on the expertise of each other to question and validate the survey instruments. Each of the cohort members also contributed to the research design and creation of surveys. The cohort members are experts in the field of education technology in Alaska with leadership roles including the former commissioner of education for the State of Alaska, a CEO for a non-profit Education Leadership organization, a Director for the Consortium for Digital Learning with the Association of Alaska School Boards; and the Director of SchoolAccess, providing telecommunications for most of Alaska's schools. Each of these members is seen as a leader in the education community and this brings both expertise and potential bias to the study; however, with each cohort member contributing different aspects to the survey, along with the use of outside experts to validate and verify data, the biases present are minimal.

3.4.12 Survey internal reliability.

Internal reliability of the survey questions in both teacher and student surveys were established using Chronbach Alpha. Questions using like items in SPU LoA, SCU LoA, TPU LoA, and TCU LoA were matched to like items in questions asked in the internet use sections of the survey. Chronbach Alpha results for survey items are provided in Table 4.

Table 4

Chronbach Alpha Survey Items

Questionnaire Category	N of Items	Chronbach's Alpha
Teacher Classroom Use (TCU)	34	.948
Teacher Personal Use (TPU)	41	.947
Student Classroom Use (SCU)	42	.934
Student Personal Use (SPU)	42	.906

3.4.13 Survey administration.

A communication plan was created with delegation of responsibilities for disseminating the surveys to the school districts identified in the study and a calendar window for administering the survey was set for April 15 - June 1, 2011. The survey window was selected for the end of the school year to ensure teachers and students had at least one school year of instructional experience in the one-to-one laptop program.

Concurrently, one of our four cohort members, Mark Standley, conducted five focus groups in Northwest Arctic Borough School District, Dillingham City School District, Cordova City School District, and Lower Kuskokwim School District. These focus groups were administered with groups of four to eight students in each school, lasting approximately one hour and were held during school hours.

3.5 Analysis of the Quantitative Data

Quantitative research can be explained as a phenomena that used mathematically based methods by collecting numerical data (Muijs, 2010). Numerical data was collected through the surveys discussed above for both teacher and students. All variables were labeled nominal, ordinal, or interval/scale. Quantitative methods used inferential statistics to seek conclusions about two groups (teachers and students) using two different surveys.

Quantitative analysis was conducted using IBM SPSS version 19 software. Demographic data was analyzed using descriptive crosstabs to identify frequencies for gender, age, ethnicity, tenure in current school, and tenure in laptop program for both students and teachers within three categories of broadband availability. A one-way

ANOVA was used to show the differences in means given three categories of community broadband availability.

3.5.1 Student perceptions and use statistical analyses.

Students responded to survey questions to identify use of laptop in core subject areas to include math, English, and science with requirements for internet at school and home. Students also responded to survey questions in reference to time spent on internet at home for schoolwork. Statistical analysis for each question is shown in Table 5.

Table 5

Student Laptop Use at Home

Variable item	Data Type	Statistical Test
Student Survey: Q2.8.1.1, Q2.8.1.2, Q2.8.2.1, Q2.8.2.2, Q2.8.3.1, Q2.8.3.2 Q3.3.1	Nominal, Non-Parametric	Descriptive, Crosstab, frequencies.
Student Survey: Q4.4, Q4.5	Scale/Interval data, Parametric	Chi Square, crosstabs

Student Personal Use (SPU) LoA total use index was measured using a one-way ANOVA to measure the differences between SPU LoA, given three categories of community broadband availability. Statistical analysis used is shown in Table 6.

Table 6

Student Personal Use (SPU) Levels of Adoption (LoA)

Variable item	Data Type	Statistical Test
Student Survey: Student Personal Use (SPU) Total Index	Scale, Parametric	ANOVA Independent Variable: Broadband Access category Dependent Variable: SPU LoA

Student Classroom Use (SCU) LoA total use index was measured using a one-way ANOVA to measure the differences between SCU LoA across three categories of community broadband availability. Statistical analysis procedure is shown in Table 7.

Table 7 *Student Classroom Use (SCU) Levels of Adoption (LoA)*		
Variable item	Data Type	Statistical Test
Student Survey: Student Classroom Use (SCU) Total Index	Scale, Parametric	ANOVA Dependent Variable: SCU LoA Independent Variable: Broadband Access category

3.5.2 Teachers' perception and use statistical analyses.

Teachers responded to survey questions to identify use of laptop in reference to time spent on internet at home for work related to school. Statistical analysis for each question is shown in Table 8.

Table 8 *Teacher Laptop Use at Home*		
Variable Item	Data Type	Statistical Test
Teacher Survey: Q4.3, Q4.4	Nominal, Non-parametric	Descriptive, Crosstab, frequencies

Teacher Personal Use (SPU) LoA total use index was measured using a one-way ANOVA to measure the differences between TPU LoA across three categories of community broadband availability. Statistical analysis procedure is shown in Table 9.

Table 9 *Teachers Personal Use (TPU) Levels of Adoption (LoA)*		
Variable Item	Data Type	Statistical Test
Teacher Survey: Teacher Personal Use (TPU) Index	Scale, Parametric	ANOVA Dependent Variable: TPU LoA Independent Variable: Broadband Access category

Teacher Classroom Use (SCU) LoA total use index was measured using a one-way ANOVA to measure the differences between TCU LoA across three categories of community broadband availability. Statistical analysis procedure is shown in Table 10.

Table 10 *Teachers Classroom Use (TCU) Levels of Adoption (LoA)*		
Variable Item	Data Type	Statistical Test
Teacher Survey: Teacher Classroom Use (TPU) Index	Scale, Parametric	ANOVA Dependent Variable: TCU LoA Independent Variable: Broadband Access category

Teachers responded to survey questions referencing the frequency of developing and using online resources for their students to use at school and home. Statistical analysis used is shown in Table 11.

Table 11 *Teachers Online Resources for Student*		
Variable item	Data Type	Statistical Test
Teacher Survey Q3.2, Q3.3	Nominal, Non-parametric	Descriptive frequencies, Crosstab, Chi-Square

3.6 Analysis of the Qualitative Data

Much like quantitative design, qualitative design approach to data analysis requires the researcher to work within a theoretical framework to shape the context of the research. The researcher must frame his/her philosophical assumptions in the research design (Creswell, 2009). In this study, the researcher focused on ontological philosophical assumptions to understand the realities of participants to create a phenomenological report, whereby the researcher used quotes and themes in the words of participants to complement the survey data gathered through quantitative measures (Creswell, 2007; Moustakas, 1994). Qualitative analysis used open coding to create thematic categories of responses from two open-ended questions from students and two open-ended questions from teachers. The thematic codes or categories provided the researcher with a better understanding of the context of the digital divide for students and teachers in one-to-one laptop programs in Alaska's high schools.

Coding for open-ended questions used a categorical analysis to create themes (Kvale & Brinkmann, 2009) used by the researcher to gain a better understanding of the quantitative data gathered. Inter-reliability for the categorical coding for this study involved each of the cohort members reviewing and validating the themes that evolved. In addition to the open-ended questions administered with the quantitative survey, a fourth cohort member conducted focus groups with students in population sample.

3.6.1 Overview of focus groups.

Focus groups were conducted in five school districts including, (a) Northwest Arctic Borough; (b) Dillingham City; (c) Cordova; (d) Petersburg; and (e) Lower Kuskokwim School Districts. The focus groups were conducted during the school day with four to eight students selected by the principal of each school. Each of the five focus groups received the same set of 12 questions (Appendix D), with each of the cohort member contributing one question referencing his/her research. Each focus group session lasted approximately 1 hour and 10 minutes in a classroom location with minimal disruptions. Categorical themes emerged and were compared across the bandwidth availability and open-ended questions in the quantitative survey for students.

3.6.2 Analysis of focus group and open-ended questions.

Open-ended questions and focus group categorical themes were coded within each of the categories for bandwidth availability for students. Open-ended questions were coded within the teacher survey in the same three categories. The qualitative data is used to complement the survey data for students and teachers.

3.7 Triangulation of the Data Summary

Triangulation in reference to social sciences refers to using more than one approach or method to ensure confidence in the findings of the researchers' questions (Bryman, 1999). Many researchers argue that triangulation increases the accuracy of the study and provides a measure of validity and removes bias (Creswell, 2007; Denzin, 1970; Webb, Campbell, Schwartz, & Sechrest, 1966). In 1970, Denzin extended the definition of triangulation to include four distinct forms of triangulation to include: (a) data triangulation; (b) investigator triangulation; (c) theoretical triangulation; and (d) methodological triangulation. Data triangulation provides the researcher with multiple sampling strategies, in that data is gathered at different times. Investigator triangulation refers the use of more than one researcher used to gather and interpret the data. Theoretical triangulation refers to the researcher having more than one theoretical position in interpreting the data. Lastly, methodological triangulation refers to the researcher using more than one method to gather data (Denzin, 1970).

The design for this study used both methodological triangulation and investigator triangulation. Denzin makes a distinction in methodological triangulation to include "within-method" and "between-method" triangulation. The cohort model coupled with mixed methods approach, created a natural measurement for triangulation in both methodological and investigator triangulation. Standley's (2012) qualitative research through the use of focus groups allowed for a secondary researcher to validate the findings from the open-ended question within the quantitative survey instrument developed and used by Whicker (2012) and Lloyd (Standley, 2012; Whicker, 2012). This investigative approach enhances the confidence in the findings.

3.8 Summary

This chapter summarizes the research design using a mixed-methods approach to seek a better understanding of the digital divide in Alaska's high school one-to-one laptop programs.

Chapter 4: Results

Chapter four provides the results for this mixed methods study with quantitative and qualitative analyses across three categories of community broadband availability for teachers and students. This study examined the Personal and Classroom Use Levels of Adoption (LoA) for teachers and students. A 215-item survey for teachers, and a 100-item survey for students were analyzed quantitatively, with coding from open-ended questions providing qualitative results. Chapter four is organized in three major sections to include: (a) demographic information for teachers and students; (b) quantitative data analysis; and (c) qualitative data analysis.

4.1 Teacher Demographic Data

The total teacher sample population (n=94) is compared across three categories of community broadband availability as defined by the FCC (2010) in the home to include: (a) broadband availability via terrestrial fiber or microwave middle-mile delivery; (b) broadband availability via satellite middle-mile delivery; and (c) no broadband available to communities that are served with satellite for middle-mile delivery of internet services. The teacher sample across these categories is comprised of nine demographic characteristics including, (a) age; (b) gender; (c) ethnicity; (d) tenure at school; (e) teaching tenure; (f) years taught in one-to-one laptop program; (g) professional development; (h) perceived technology proficiency; and (i) perceptions for internet access options. This section provides distribution of frequency and percentage of teachers within each of the three categories of broadband availability.

4.1.1 Teacher age and gender.

The sample distribution of teachers (n=28) located in communities where terrestrial broadband is available is comprised of 35.7% male teachers and 64.3% female teachers. The sample distribution of teachers (n=20) located in communities where broadband is available through satellite delivery is comprised of 65.0% male teachers, and 35.0% female teachers. The sample distribution with the largest group of teachers (n=46) is located in communities that do not offer broadband delivery, and is comprised of 58.7% male teachers and 41.3% female teachers. The most significant difference in male and female teacher distribution is found in communities with terrestrial broadband availability and satellite broadband availability with more female to male teacher ratio in the terrestrial broadband availability and more male to female ratio in the satellite broadband availability as shown in Table 12.

Table 12

Teacher Gender

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Male	10	35.7%	13	65.0%	27	58.7%
Female	18	64.3%	7	35.0%	19	41.3%
Total N	28	100.0%	20	100.0%	46	100.0%

The distribution of teacher age is about the same in the terrestrial and satellite community broadband availability categories, with the highest percentage of teachers in the 30-39 years of age category (about 35% each). The distribution of teacher age is slightly different in the category of no community broadband availability with about a third of the teachers, falling in the 50-59 year age group. Table 13 provides a full distribution by frequency and percent.

Table 13

Teacher Age

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
Age Group	Frequency	Percent	Frequency	Percent	Frequency	Percent
20-29 years	1	3.6%	4	20.0%	8	17.4%
30-39 years	10	35.7%	7	35.0%	12	26.1%
40-49 years	5	17.9%	3	15.0%	7	15.2%
50-59 years	9	32.1%	5	25.0%	15	32.6%
60 years or older	3	10.7%	1	5.0%	4	8.7%
Total N	28	100.0%	20	100.0%	46	100.0%

4.1.2 Teacher tenure.

Teacher tenure depicts total years of teaching experience compared across three categories of community broadband availability. All three categories of community broadband availability show the largest group of teachers having 11 or more years of experience with 75% of teachers (n=28) in the terrestrial community broadband category, 45% of the teachers (n=20) in the community satellite broadband, and 45.7% of the teachers (n=46) in the community with no broadband availability category. This demonstrates that the sample of teachers involved in this study, are mostly experienced teachers. The distribution of frequency is shown in Table 14.

Table 14

Total Tenure in Teaching

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Less than 1 year	0	0.0%	1	5.0%	4	8.7%
1-5 years	3	10.7%	5	25.0%	13	28.3%
6-10 years	4	14.3%	5	25.0%	8	17.4%
11 or more years	21	75.0%	9	45.0%	21	45.7%
Total N	28	100.0%	20	100.0%	46	100.0%

Teacher tenure in the current school compared across three categories of community broadband availability show the largest percentage of teachers in terrestrial and satellite community broadband availability categories as having 5 or more years in their current school. These results are not surprising as teacher turnover in rural Alaska has been reported to be twice as much as urban districts in Alaska (Hirshberg & Hill, 2006). The terrestrial broadband available category has 64.3% of its teachers (n=28), and the satellite community broadband available category has 40% of its teachers (n=20) with 5 or more years in the current school. This is compared to the category of no community broadband available category with the largest percentage of 41.3% of teachers (n=46) having 3-4 years teaching experience in their current school as shown in Table 15.

Table 15

Years Teaching in Current School

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Less than 1 year	3	10.7%	4	20.0%	9	19.6%
1-2 years	2	7.1%	4	20.0%	10	21.7%
3-4 years	5	17.9%	4	20.0%	19	41.3%
5 or more years	18	64.3%	8	40.0%	8	17.4%
Total N	28	100.0%	20	100.0%	46	100.0%

4.1.3 Years taught in a one-to-one laptop program.

Comparisons across all three categories of community broadband availability represent the majority of teachers having 3 or more years experience teaching in a one-to-one laptop program, with 40.7% of teachers (n=28) in terrestrial having the most experience in teaching in a one-to-one laptop program. Teachers with no community broadband available make up the largest group with 50% of its teachers (n=46) having 3-4 years of teaching experience in a one-to-one laptop program. The distribution across all three categories of community broadband availability show approximately two-thirds of the sample distribution of teachers have a teaching tenure of three or more years of experience in a one-to-one laptop program. The distribution of frequencies is shown in Table 16.

Table 16

Years Taught in One-to-One Laptop Programs

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Less than 1 year	4	14.3%	3	15.0%	7	15.2%
1-2 years	4	14.3%	4	20.0%	8	17.4%
3-4 years	9	32.1%	5	25.0%	23	50.0%
5 or more years	11	39.3%	8	40.0 %	8	17.4%
Total N	28	100.0%	20	100.0%	46	100.0%

4.1.4 Teacher ethnicity.

Across all three categories of community broadband availability, teachers identified themselves as predominately White. The highest percentage with 91.3% of the teachers (n=46) was in communities where broadband is not available as shown in Table 17.

Table 17

Teacher Ethnicity

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
White	23	82.1%	15	75.0%	42	91.3%
Black or African American	0	0.0%	1	5.0%	0	0.0%
Hispanic/Latino	0	0.0%	0	0.0%	1	2.2%
Alaska Native/American Indian	1	3.6%	1	5.0%	2	4.3%
Other not listed	4	14.3%	3	15.0%	1	2.2%
Total N	28	100.0%	20	100.0%	46	100.0%

4.1.5 Professional development.

Professional Development was a component of the complete solution for a one-to-one laptop program implementation. All districts received professional development hours as part of the grant/match program that had to be used within the first three years of implementation (Association of Alaska School Boards, 2006). The teachers in the category of terrestrial community broadband available received the most professional development hours with 26.9% of the teachers (n=26) receiving 25 to 40 hours of training provided by their school district. The lowest number of professional development hours provided by school districts for teachers was in the category of community with no broadband availability with 71.4% of the teachers (n=46) that received 8 hours or less as shown in Table 18.

Table 18

Professional Development Hours Provided by School District

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
8 hours or less	4	15.4%	6	30.0%	25	71.4%
9 to 24 hours	3	11.5%	6	30.0%	13	28.3%
25 to 40 hours	7	26.9%	5	25.0%	4	8.7%
41 to 60 hours	4	15.4%	1	5.0%	3	6.5%
61to 80 hours	6	23.1%	2	10.0%	1	2.2%
Total N	26	100.0%	20	100.0%	46	100.0%

Teachers were also asked to provide the number of hours of professional development they participated in outside of school hours. This distribution paralleled that of the district provided professional development. The teachers in the terrestrial community broadband available category participated in the most professional development hours outside of school hours with 46.2% of the teachers (n=26) having more than 27 hours. The teachers with no broadband available in their community participated in the lowest number of professional development during after school hours with 64.0% of the teachers (n=46) that did not participate in any professional development beyond the school day as shown in Table 19.

Table 19

Professional Development Hours Outside of School

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
None	6	21.1%	3	15.0%	16	64.0%
3 hours or less	3	11.5%	4	20.0%	8	17.4%
4 to 9 hours	1	3.8%	3	15.0%	10	21.7%
10-18 hours	4	15.4%	3	15.0%	1	2.2%
19-27 hours	0	0.0%	2	10.0%	1	2.2%
More than 27 hours	12	46.2%	5	25.0%	10	21.7%
Total N	26	100.0%	20	100.0%	46	100.0%

4.1.6 Teacher perceived level of proficiency.

Teachers were asked to rate their proficiency level of technology adoption using the framework developed by Rogers (2003). The comparison across all three categories of community broadband availability show the majority of teachers rating themselves as experienced in technology proficiency, as shown in Table 20.

Table 20

Teacher Perceived LoA

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Beginner	0	0.0%	0	0.0%	1	2.2 %
Intermediate	12	42.9%	6	30.0%	16	34.8%
Experienced	11	39.3%	12	60.0%	21	45.7%
Expert	5	17.9%	2	10.0%	8	17.4%
Total N	28	100.0%	20	100.0%	46	100.0%

4.1.7 Teacher perception of home internet access.

Teacher options for internet access compared across community broadband availability show 34.8% of teachers (n=46) in communities where broadband is not available do not have access to internet in the home. Followed by those teachers in satellite community broadband availability with 14.3% of teachers (n=20) without access to internet in the home. Lastly, teachers in terrestrial community broadband availability category showed the fewest number with 7.1% of teachers (n=28) without access to the internet in the home, as shown in Table 21. Based on the community broadband availability defined in Appendix B, the distribution of frequency and percentages is expected.

Table 21

Teacher Options for Internet Access

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
I don't have internet Access at home	2	7.1%	3	14.3%	16	34.8%
DSL	8	28.6%	5	25.0%	15	32.6%
Cable Modem	13	46.4%	9	45.0%	0	0.0%
Satellite Dish	1	3.6%	0	0.0%	8	17.4%
Microwave	1	3.6%	1	5.0%	0	0.0%
Other	2	7.1%	0	0.0%	5	10.9%
I don't know	1	3.6%	2	10.0%	2	4.3%
Total N	28	100.0%	20	100.0%	46	100.0%

4.2 Student Demographic Data

The total student sample (n=725) is divided into the same three categories, as the teacher sample was, based on community broadband availability as defined by the FCC (2010) in the home to include: (a) broadband availability via terrestrial fiber or microwave middle-mile delivery; (b) broadband availability via satellite middle-mile delivery; and (c) no broadband available to communities that are served with satellite for middle-mile delivery of internet services. The student sample distribution across these categories is comprised of seven demographic characteristics including, (a) age; (b) gender; (c) ethnicity; (d) years in current school; (e) years participating in a one-to-one laptop program; (f) perceived technology proficiency; and (g) perceptions for internet access options. This section provides distribution of frequency and percentage of students within each of the three categories of broadband availability.

4.2.1 Student age and gender.

The distribution of students (n=243) located in communities where terrestrial broadband is available is comprised of 51.4% male students and 48.6% female students. The distribution of students (n=100) located in communities where broadband is available through satellite delivery is comprised of 56.0% male students and 44.0% female students. The distribution with the largest group of students (n=382), located in communities that do not offer broadband delivery is comprised of 46.9% male students and 53.1% female students. The distribution between male and female students across all community broadband availability categories is about equal, as is shown in Table 22.

Table 22

Student Gender

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Male	125	51.4%	56	56.0%	179	56.9%
Female	118	48.6%	44	44.0%	203	53.1%
Total N	243	100.0%	100	100.0%	382	100.0%

The distribution of age for students across all categories of community broadband availability has a wider spread in the 12-19 years of age in the no broadband available category, whereas, the terrestrial and satellite broadband availability categories include less of the younger aged student demographics. Younger students identified in the distribution for no broadband availability category may be due to the nature of rural education with multi-aged classrooms that would include a wider spread of students, even though they may be in a high school program. Table 23 shows the distribution and frequency for student age.

Table 23

Student Age

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
12 years old	0	0.0%	0	0.0%	5	1.3%
13 years old	0	0.0%	1	1.0%	11	2.9%
14 years old	34	14.0%	0	0.0%	25	6.5%
15 years old	91	37.4%	28	28.0%	78	20.4%
16 years old	55	22.6%	25	25.0%	85	22.3%
17 years old	35	14.4%	20	23.0%	90	23.6%
18 years old	25	10.3%	23	23.0%	55	14.4%
19 years old	1	.4%	2	2.0%	25	6.5%
None of the Above	2	.8%	1	1.0%	8	2.1%
Total N	243	100.0%	100	100.0%	382	100.0%

4.2.2 Student ethnicity.

The terrestrial community broadband availability category had a distribution frequency of 69.5% of its students (n=243) self-identified as White. Both of the other two communities of students self-identified themselves primarily as Alaska Native/American Indian with 45.0% of students (n=100) in communities where satellite broadband was available, and 89.5% of students (n=382) in communities with no community access to broadband, as shown in Table 24.

Table 24

Student Ethnicity

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
White	169	69.5%	26	26.0%	20	5.2%
Black or African American	6	2.5%	4	4.0%	4	1.0%
Hispanic/Latino	10	4.1%	4	4.0%	3	.8%
Asian Islander	16	6.6%	8	8.0%	5	1.3%
Alaska Native/American Indian	31	12.8%	45	45.0%	342	89.5%
Other not listed	11	4.5%	13	13.0%	8	2.1%
Total N	243	100.0%	100	100.0%	382	100.0%

4.2.3 Student tenure in a one-to-one laptop program.

Student years in the current school distribution across community broadband availability categories show the largest percentage (66.8%) of students (n=382) with 6 or more years in their current school in no community broadband available category. In contrast, the distribution of students in the terrestrial community broadband available category have the highest percentage (37.9%) of students (n=243) who have been in the current school for less than one year as shown in Table 25.

Table 25

Student Years in Current School

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Less than 1 year	92	37.9%	12	12.0%	27	7.1%
1-2 years	59	24.3%	42	42.0%	28	7.3%
3-5 years	69	28.4%	40	40.0%	72	18.8%
6 or more years	23	9.5%	6	6.0%	255	66.8%
Total N	243	100.0%	100	100.0%	382	100.0%

The distribution in the number of years students participated in one-to-one laptop programs represent differences across the categories of community broadband availability. The terrestrial community broadband available category had 34.6% of students (n=243) with less than one year of experience in a laptop program. In contrast, both the satellite community broadband available category and the students in communities without broadband access showed the majority of students having 3-4 years experience in the laptop program as shown in Table 26.

Table 26

Student Years in One-to-One Laptop Program

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
I do not have a school issued laptop	37	15.2%	22	22.0%	19	5.0%
Less than 1 year	84	34.6%	5	5.0%	58	15.2%
1-2 years	57	23.5%	16	16.0%	94	24.6%
3-4 years	65	26.7%	36	36.0%	178	46.6%
5 or more years	0	0.0%	21	21.0%	33	8.6%
Total N	243	100.0%	100	100.0%	382	100.0%

4.2.4 Student perceived level of proficiency.

Students were asked to rate their proficiency level of technology adoption using the framework developed by Rogers (2003). The comparison across all three categories of community broadband availability show the majority of students rating themselves as experienced in technology proficiency, with the full distribution for each of the three categories of broadband availability being very similar, as shown in Table 27.

Table 27

Student Self-Perceived Levels of Technology Adoption

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Non-user	1	.4%	0	0.0%	16	4.2%
Beginner	10	4.1%	3	3.0%	50	13.1%
Intermediate	97	39.9%	34	34.0%	148	38.7%
Experienced	112	46.1%	49	49.0%	149	39.0%
Expert	23	9.5%	14	14.0%	19	5.0%
Total N	243	100.0%	100	100.0%	382	100.0%

4.3 Student and Teacher Perceptions of Use

This section provides additional data to provide the researcher with a fuller picture of the perceptions of students and teachers compared across three categories of community broadband availability. In addition, student perceptions regarding broadband in the home related to their, (a) success as a student; (b) availability of personal computer in the home; and (c) use patterns for schoolwork is included in this section.

4.3.1 Teacher options for home internet access.

Teacher options for internet access compared across community broadband availability show 34.8% of teachers (n=46) in communities where broadband is not available do not have access to internet in the home. This is very similar to the percentage of students for this category of broadband availability. Followed by those teachers in terrestrial community broadband availability category with 15.0% of teachers (n=20) without access to internet in the home. Approximately half of the teachers in both terrestrial and satellite communities with broadband availability have cable modems. Lastly, teachers in the satellite community broadband availability category showed the highest percentage with 17.4% of teachers (n=46) using satellite dish delivery for home internet access. The distribution of frequencies is shown in Table 28.

Table 28

Teacher Options for Home Internet Access

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
I don't have internet Access at Home	2	7.1%	3	15.0%	16	34.8%
DSL	8	28.6%	5	25.0%	15	32.6%
Cable Modem	13	46.4%	9	45.0%	0	0.0%
Satellite Dish	1	3.6%	0	0.0%	8	17.4%
Microwave	1	3.6%	1	5.0%	0	0.0%
Other	2	7.1%	0	0.0%	5	10.9%
I don't know	1	3.6%	2	10.0%	2	4.3%
Total N	28	100.0%	20	100.0%	46	100.0%

4.3.2 Student options for home internet access.

Student options for internet access compared across community broadband availability show 31.2% of students (n=382) in communities where broadband is not available do not have access to internet in the home, followed by those students in terrestrial community broadband availability category with 5.3% of students (n=243) without access to internet in the home. A large percentage of students across all three categories of broadband availability did not know what kind of delivery option they had in the home for internet access; however, it is assumed they had internet access but did not know the delivery method for that access. Lastly, students in the satellite community broadband availability category showed the fewest number with 2.0% of students (n=100) without access to the internet in the home, as shown in Table 29.

Table 29

Student Option for Home Internet Access

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
I don't have internet Access at Home	13	5.3%	2	2.0%	119	31.2%
DSL	49	20.2%	21	21.0%	72	18.8%
Cable Modem	66	27.2%	32	32.0%	28	7.3%
Wireless internet	8	3.3%	3	3.0%	5	1.3%
Satellite Dish	4	1.6%	3	3.0%	16	4.2%
Microwave	1	.4%	6	6.0%	2	.5%
Fiber	8	3.3%	1	1.0%	1	.3%
I don't know	94	38.7%	32	32.0%	139	36.4%
Total N	243	100.0%	100	100.0%	382	100.0%

4.3.3 Student focus groups.

Qualitative data revealed through focus groups with students in each of the three categories of community broadband availability further illuminated the students' perceived differences in bandwidth-speed. Students from three of the four schools were asked to rate their home bandwidth on a scale of one to ten with one being the lowest speed and ten being the highest speed. The three focus groups represent each of the three categories of community broadband availability. The quotes from students in these communities provide additional data that not available quantitatively, allowing for a more complete picture.

Kwethluk, a village located in the Lower Kuskokwim school district had four students participate in focus groups. These students live in a community with no broadband availability. Four students in Kwethluk participated in the focus group conversation led by Standley (2012), and had the following responses to the question regarding bandwidth speed: student 1 stated, "we don't have internet at home;" Student 2 responded, "zero, we don't have internet," Student 3 said, "just about 1, it's really slow. It's dial up;" and Student 4 responded with "yeah, we don't, we can't.

A second focus group was conducted in Cordova, Alaska, a community with broadband available via satellite middle mile delivery. Eight students in Cordova participated in the focus group conversation led by Standley (2012) and had the following responses to the question regarding bandwidth speed: student 1 responded "really slow;" Student 6 responded, "we're talking about internet on our school laptop? It's pretty fast, six;" Student 3, after asking clarifying questions, responded "I'm sorry, two;" Student 7 responded, "Um, I live near here and at the school it's faster than anywhere in the city, so I'd say the school's is probably about a six and at home it's probably a three and I'd say school's probably about a five, home's probably about a three. But when we take our laptops like to other places and we're able to use them like Anchorage for example, it's a lot faster and easier to get stuff done because they have probably about an eight;" Student 8 responded, "Mine would be a two or a three depending on the day;" Student 2 responded, "Mine would have to be anywhere between three to five depending on what I'm downloading and what day it is;" And student 4 responded, "I'd say three to four;" lastly, student 5 responded "four."

A third focus group was conducted in Petersburg, Alaska, a community with terrestrial broadband available. Six students participated in a focus group conversation led by Standley (2012) and had the following responses to the question regarding bandwidth speed: student 1 said, "I do have internet at home and I don't know, maybe a six. I don't know, it depends for ah for just researching and looking up pages it's pretty fast but then when you go to the you-tube videos or something that requires like flash, moving things it slows down a lot, but my home computer, the Dell, it when you're researching just pages, it can take a little while and like YouTube videos things that require flash upload no problem." Student five responded, "ah yeah, I do have wireless at my house um and I would say it's pretty fast, I don't know, it's about the same as the school's so I don't know. It's like maybe a 7 or 8, so it's pretty fast... yeah, it's pretty nice to use. I don't have any trouble with it;" Student 4 responded "I would say probably about a 7;" Student 3 responded, "I would say probably a 7 or 8;" Student 6 responded, "It depends if you're on Wi-Fi or connected with Ethernet. I've got both. With Ethernet, I'll say a 7, with Wi-Fi I'd say a 3;" Student 2 responded, "Ah, I live in two different places, so in excel my Dad's is pretty good, it just sometimes shorts out, so I'd say a 7 or an 8 and sometimes maybe a 9, pretty much like the school's. At my mom's house out at Seivert's subdivision, which is kind of at the ferry terminal, it is sometimes slower and not as dependable so I'd say a 6."

The difference between the three group responses is varied with the students living in areas where broadband is not available providing responses with no broadband availability, whereas, those students with broadband available via satellite shared their internet speed was better at school than at home. Lastly, students in communities where terrestrial broadband was available rated their internet speeds much higher and even the comparisons with school and home were very similar.

4.3.4 Student perceptions of home internet access.

Students were asked if having internet access at home would make them a better student or help them to be more successful. While students across all categories of community broadband availability believe that having internet access makes them a better student, the highest percentage of students believing that having internet access at home made them successful was 70.4% of students (n=230) living in the community where broadband is available through terrestrial delivery. In contrast, students living in communities with no broadband availability had the lowest percentage with 41.4% of the students believing that internet access at home would make them a more successful student. The distribution of frequencies is shown in Table 30.

Table 30

Student Perception that Internet Makes Them Better Students

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
Having internet access makes me a better student.	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	162	70.4%	65	66.3%	109	41.4%
No	11	4.8%	3	3.1%	21	8.0%
Maybe	45	19.6%	24	24.5%	101	38.4%
I don't know	12	5.2%	6	6.1%	32	12.2%
Total N	230	100.0%	98	100.0%	263	100.0%

4.3.5 Student access to personally owned computers at home.

Students were asked if they had access to a personal computer in their home. Students with the greatest access to a computer at home lived in communities where satellite broadband was available with 88% of the students (n=100) having a home computer available for their use. In contrast, students living in communities where broadband is not available had the largest percentage without access at home showing 44% of the students (n=382) without a home computer, as shown in Table 31.

Table 31

Student Use of Personal-Owned Computer at Home

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
Do you have a personal computer at home that you can use?	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	192	79.0%	88	88.0%	213	55.8%
No	51	21.0%	12	12.0%	169	44.2%
Total N	243	100.0%	100	100.0%	382	100.0%

4.3.6 Student use of laptop for schoolwork.

Students were asked if they used their laptop at home for schoolwork. The majority of students across all three categories of community broadband availability responded favorably to using their laptops at home for schoolwork. The distribution of frequency in communities with terrestrial broadband available show that 95.1% of the students (n=243) use their laptop for schoolwork, while communities without broadband access show that 79.3% of the students (n=382) use their laptop for schoolwork, as shown in Table 32.

Table 32

Student use of Laptop for Schoolwork at Home

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
Do you use your laptop at home for schoolwork?	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	231	95.1%	91	91.0%	302	79.3%
No	12	4.9%	9	9.0%	79	20.7%
Total N	243	100.0%	100	100.0%	382	100.0%

4.3.7 Teacher perceptions of student laptop use for schoolwork.

Teachers were asked if they believed their students used the laptop at home for schoolwork. There was a notable difference among teachers in the three categories of community broadband availability. Teachers in communities where no broadband access is available had the highest percentage, with about 75% of the teachers responding with a no, or I don't know if my students use their laptop at home for schoolwork. This is a contrast to what students reported in this category of broadband availability as 80% of the students responded with yes, they use their laptop for schoolwork. Teachers in terrestrial community broadband availability had approximately 75% of the teachers believing that their students use their laptops at home for schoolwork. The distribution of frequency for teacher perceptions regarding the use of laptops at home for schoolwork is shown in Table 33.

Table 33

Teacher Perception of Student Laptop Use for Schoolwork

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
My students use their laptop at home for schoolwork.	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	20	71.4%	9	45.0%	11	23.9%
No	4	14.3%	4	20.0%	21	45.7%
I don't know	4	14.3%	7	35.0%	14	30.4%
Total N	28	100.0%	20	100.0%	46	100.0%

4.4 Quantitative Analysis Results

Quantitative analysis was conducted using IBM SPSS version 19 software. Data was analyzed using descriptive crosstabs to identify frequency and percentage distributions, chi-square for categorical data, and ANOVA for continuous data to provide an understanding of the differences in personal and classroom use levels of adoption for teachers and students compared across three categories of community broadband availability. The sections below provide results from statistical analysis for the hypotheses from the investigative questions to support the overarching question, "Does broadband availability in a school community have an impact on the teaching and learning experience for teachers and students in a one-to-one laptop program?" In addition, descriptive statistics were used to provide a more complete picture for the research and to provide supportive detail for the investigative questions below.

4.4.1 Student laptop use at home.

Students were asked to identify time spent using their school-issued laptop on the internet for home use. There were 119 students who identified themselves as not having internet access at home and the survey instrument allowed them to skip this question. Students who had internet access (n=591) were asked how many hours they spent using their laptop at home. This question was meant to measure the time spent using the laptop at home and did not capture any specific use cases such as schoolwork. Research question two differentiates the hours spent by students in using their laptop for schoolwork. A one-way ANOVA was used with continuous data to measure the spread of the distribution of the means, compared across three categories of community broadband availability to answer the question regarding access to broadband in the home and home use of the internet.

Research Question 1: Does access to broadband in the home make a difference in the amount of time spent by students using the laptop on the internet for home use?

1. Null Hypothesis H_0: There is no difference in the amount of time spent by students, using their laptop on the internet for home use, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in the amount of time spent by students, using their laptop on the internet for home use, given the three categories of community broadband availability.

There was a significant difference in the number of hours students spent using their laptop on the internet at home compared across three categories of community broadband availability, as reported using a one-way ANOVA, ($F_{2,590}$=13.537, p=<.001). Further verification using post hoc tests, Tukey and Bonferroni, found no significant differences in mean differences between those students in terrestrial community broadband availability and those students in satellite community broadband availability. Approximately 80% of students living in communities with no broadband available spend less than 3 hours per day. The null hypothesis is rejected and in fact, there is a significant difference in the number of hours spent on the internet at home for comparing students living in communities with no broadband access and those students living in communities with broadband availability whether the availability is via terrestrial or satellite. The distribution of frequencies is shown in Table 34.

Table 34

Hours Spent on Internet at Home

Comparison based on Community Broadband Availability						
Time Spent per day	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Less than 3 hours per day	143	62.2%	55	56.1%	209	79.5%
3 or more hours per day	87	37.8%	43	43.9%	54	20.5%
Total N	230	100.0%	98	100.0%	263	100.0%

4.4.2 Student laptop use at home for schoolwork.

There were 119 students who identified themselves as not having internet access at home and the survey instrument allowed them to skip this question. Students who had internet access (n=591) were asked how many hours they spent using their laptop for schoolwork at home. This question was meant to measure the time spent using the laptop specifically for schoolwork at home. A one-way ANOVA was used to measure the spread of the distribution of the means, compared across three categories of community broadband availability to answer the question regarding access to broadband in the home and home use of the internet for schoolwork.

The results were compared across the three categories of community broadband availability below. A one-way ANOVA was used to investigate the difference in means for continuous data to answer the question regarding access to broadband in the home and home use of the internet for schoolwork.

Research Question 2: Does access to broadband in the home make a difference in the amount of time spent by students on the laptop using the internet for schoolwork?

1. Null Hypothesis H_0: There is no difference in the amount of time spent by students using the laptop on the internet for schoolwork given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in the amount of time spent by students using the laptop on the internet for schoolwork given the three categories of community broadband availability.

There was no significant difference in the number of hours students spent using their laptop on the internet at home for schoolwork compared across three categories of community broadband availability, as reported using an analysis of variance (ANOVA) ($F_{2,590}$=. 897, p=.408). Approximately 80-90% of students across all three categories of community broadband availability spent less than 3 hours per day using the internet at home for schoolwork. The null hypothesis is accepted. The distribution of frequencies is shown in Table 35.

Table 35

Hours Spent on the Internet at Home for Schoolwork

Comparison based on Community Broadband Availability						
Time Spent per day	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Less than 3 hours per day	212	92.2%	88	89.8%	233	88.6%
3 or more hours per day	18	7.8%	10	10.2%	30	11.4%
Total N	230	100.0%	98	100.0%	263	100.0%

4.4.3 Student personal use levels of adoption.

Levels of Adoption (LoA) for Student Personal Use (SPU) made up a large section of the survey that asked students a series of questions regarding personal use of technology and applications outside of the classroom. The SPU Index was a total score derived from questions referencing frequency and expertise in a variety of technology applications and uses beyond the school day that included frequency use patterns for email, blogs, wikis, social networks, photo and video sharing, social bookmarking, RSS feeds, online productivity applications, instant messaging, internet browsing, and internet searching for research and information. In addition, students were asked to identify statements of personal use using a likert scale (not at all like me, a little like me, somewhat like me, a lot like me, and exactly like me) to show proficiency for those same applications. Levels of use indices created by Lemke (2009) were adapted for this survey and used in this study (Lemke, 2009). Each question was weighted depending on the complexity of the question, as outlined in Chapter Three. A one-way ANOVA was used to investigate continuous data across three categories of community broadband availability for research question three.

Research Question 3: Does access to broadband in the home make a difference in SPU LoA?

1. Null Hypothesis H_0: There is no difference in SPU LoA, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in SPU LoA, given the three categories of community broadband availability.

There was a significant difference between SPU LoA across the three categories of community broadband availability, as reported using a one-way ANOVA, ($F_{2,724}$=46.957, p=<.001). Further verification using post hoc tests, Tukey and Bonferroni, found no significant differences in frequency distribution across the three categories of broadband availability between students in terrestrial community broadband availability and those students in satellite community broadband availability. The distribution of frequencies show approximately 90% of students living in communities with no broadband availability in the bottom half of LoA, compared to students living in either terrestrial or satellite broadband available communities having approximately 90% of the students in level 2 and 3. The null hypothesis is rejected and in fact, there is a significant difference in SPU LoA comparing those students living in communities with no broadband access and those students living in communities with broadband availability whether the availability is via terrestrial or satellite. The distribution of frequencies is shown in Table 36.

Table 36

Student Personal Use Levels of Adoption

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
Levels of Adoption	Frequency	Percent	Frequency	Percent	Frequency	Percent
Level 1	21	8.6%	13	13.0%	124	32.5%
Level 2	157	64.6%	70	70.0%	227	59.6%
Level 3	58	23.9%	17	17.0%	30	7.9%
Level 4	7	2.9%	0	0.0%	0	0.0%
Total N	243	100.0%	100	100.0%	382	100.0%

4.4.4 Student classroom levels of adoption.

Levels of Adoption (LoA) for Student Classroom Use (SCU) made up the second largest section of the questions in the survey for students. The SCU Index was a total score derived from questions referencing frequency and expertise in a variety of technology applications and uses in the classroom including drill and practice, web-based testing programs, internet tutorials, publishing, spreadsheets and databases, sound and photo editing software, email, social networking, and presentations. Each question was weighted depending on the complexity of the question, as outlined in Chapter Three. A one-way ANOVA was used to investigate continuous data across three categories of community broadband availability for research question four.

Research Question 4: Does access to broadband in the home make a difference in SCU LoA?

1. Null Hypothesis H_0: There is no difference in SCU LoA, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in SCU LoA, given the three categories of community broadband availability.

Students had the option to select an additional response for the specific applications for classroom use that stated they would use the application more if was not blocked at school. This response choice created non-random missing data, resulting in n=721. There was no significant difference between SCU LoA across the three categories of community broadband availability, as reported using a one-way ANOVA, ($F_{2,721=}$4.529, p=.011) across all categories of community broadband availability. Approximately 80% of the students fell into level 1 and 2 across all three categories of community broadband availability. Therefore, the null hypothesis is not rejected. There is not enough evidence to support that there is any difference between SCU LoA across the three categories of community broadband availability. The distribution of frequencies is shown in Table 37.

Table 37

Student Classroom Use Levels of Adoption

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
Levels of Adoption	Frequency	Percent	Frequency	Percent	Frequency	Percent
Level 1	56	23.3%	47	47.0%	141	36.9%
Level 2	129	53.8%	36	36.0%	155	40.6%
Level 3	50	20.8%	14	14.0%	73	19.1%
Level 4	5	2.1%	3	3.0%	13	3.4%
Total N	240	100.0%	100	100.0%	382	100.0%

4.4.5 Schoolwork requirements for internet access at home.

Students were asked if teachers required internet access for homework assigned. Pearson's Chi-Square was used to investigate the distribution of nominal, categorical data to answer the question regarding teacher's assignments of homework that required internet access at home. Students who identified that they did not have internet access at home did not respond to this questions, therefore, n=591.

Research Question 5: Does access to broadband in the home make a difference as to whether teachers assign homework that requires internet access at home?

1. Null Hypothesis H_0: There is no difference as to whether teachers assign homework that requires internet access at home, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference as to whether teachers assign homework that requires internet access at home, given the three categories of community broadband availability.

Statistical significance was found between the categories of community broadband availability, as reported by Pearson's Chi-Square ($\chi^2(2, N=591) = 64.673$, $p=<.001$) in students reporting of teachers assigning homework requiring access to the internet at home. Approximately 80% of students in communities with terrestrial broadband available reported that teachers assigned homework that required the internet, while only 42% of the students in communities with no broadband availability reported teachers assigned homework requiring internet access in the home. The null hypothesis is rejected, since in fact, there is a significant difference in students' reporting of whether or not teachers assign homework that requires internet access at home between those students living in communities with no broadband access and those students living in communities with broadband availability. The distribution of frequencies is shown in Table 38.

Table 38

Homework Requiring Access to Internet at Home

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
My teacher assigns homework that requires internet Access at home.	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	178	77.4%	64	65.3%	111	42.2%
No	52	22.6%	34	34.7%	152	57.8%
Total N	230	100.0%	98	100.0%	263	100.0%

4.4.6 Teacher laptop use at home.

Teachers were asked to identify time spent using their school-issued laptop on the internet for home use. There were 24 teachers who identified themselves as not having internet access at home and the survey instrument allowed them to skip this question, with the majority of these teachers in the no community broadband availability category. Teachers who had internet access (n=70) were asked how many hours they spent at home using their laptop. The number of hours teachers used their laptop at home were compared across the three categories of community broadband availability. A one-way ANOVA was used to investigate the difference in means for continuous data across three categories of community broadband availability for research question six.

Research Question 6: Does access to broadband in the home make a difference in the amount of time spent using the laptop for home use?

1. Null Hypothesis H_0: There is no difference in the amount of time spent using the laptop on the internet for home use, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in the amount of time spent using the laptop on the internet for home use, given the three categories of community broadband availability.

There was no significant difference in the amount of time teachers spent using their laptop for home use across the three categories of community broadband availability as reported using a one-way ANOVA, ($F_{2,70}$=.165, p=.848). Further analysis using post hoc Tukey and Bonferroni revealed no significant difference between communities with broadband available via satellite or terrestrial. Therefore, the null hypothesis is not rejected. There is not enough evidence to demonstrate a difference across the three categories of community broadband availability in the amount of time spent by teachers using the internet on their laptops at home. The distribution of frequencies is shown in Table 39.

Table 39

Teacher Home Internet Use

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
How many hours per day do you spend on the internet at home?	Frequency	Percent	Frequency	Percent	Frequency	Percent
Less than 3 hours per day	20	71.4%	13	65.0%	20	43.5%
3 or more hours per day	4	14.3%	4	20.0%	10	21.7%
Does not have internet access at home	4	14.3%	3	15.0%	16	34.8%
Total N	28	100.0%	20	100.0%	46	100.0%

4.4.7 Teacher personal use levels of adoption.

Levels of Adoption (LoA) for Teacher Personal Use (TPU) made up a large section of the questions in the survey for teachers. The TPU Index was a total score derived from questions referencing frequency and expertise in a variety of technology applications and uses beyond the school day including email, blogs, wikis, social networking, photo and video sharing, RSS feeds, online productivity, instant messaging, internet browsing, and research/information. In addition, teachers were asked to identify statements of personal use using a likert scale (not at all like me, a little like me, somewhat like me, a lot like me, and exactly like me) to show proficiency for those same applications. Levels of use indices created by Lemke (2009) were adapted for this survey and used in this study (Lemke, 2009). A one-way ANOVA was used to investigate the TPU LoA Index range made up of continuous data across three categories of community broadband availability for research question seven. Each question was weighted depending on the complexity of the question, as outlined in Chapter Three.

Research Question 7: Does access to broadband in the home make a difference in TPU LoA?

1. Null Hypothesis H_0: There is no difference in TPU LoA, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in TPU LoA, given the three categories of community broadband availability.

There was no significant difference in TPU LoA among teachers compared across three categories of community broadband availability, as reported using a one-way ANOVA, ($F_{2,93}$=1.426, p=.246). Therefore, the null hypothesis is not rejected. The distribution of frequencies for the TPU LoA range show 75-80% of the teachers across all three categories of community broadband availability spread across Level 2 and 3 of the TPU LoA range as shown in Table 40.

Table 40

Teacher Personal Use LoA

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Level 1 LoA	5	17.9%	4	20.0%	11	23.9%
Level 2 LoA	12	42.9%	12	60.0%	24	50.0%
Level 3 LoA	9	32.1%	4	20.0%	11	23.9%
Level 4 LoA	2	7.1%	0	0.0%	0	0.0%
Total N	28	100.0%	20	100.0%	46	100.0%

4.4.8 Teacher classroom levels of adoption.

Levels of Adoption (LoA) for Teacher Classroom Use (TCU) made up a large section of the questions in the quantitative survey for teachers. The TCU Index was a total score derived from questions referencing frequency and expertise in a variety of technology applications and uses in the classroom to include use of drill and practice, web-based testing programs, learning objects, publishing, spreadsheets, databases, sound and photo editing software, social networks for collaboration, simulations, wikis, blogs, online collaboration, and video and presentation creation. A one-way ANOVA was used to investigate the TCU LoA Index range made up of continuous data across three categories of community broadband availability for research question eight. Each question was weighted depending on the complexity of the question, as outlined in Chapter Three.

Research Question 8: Does access to broadband in the home make a difference in TCU LoA?

1. Null Hypothesis H_0: There is no difference in TCU LoA, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference in TCU LoA, given the three categories of community broadband availability.

There was no significant difference in TCU LoA compared across three categories of community broadband availability as reported using a one-way ANOVA, ($F_{2,93}$=.518, p=.598). The null hypothesis is not rejected. The distribution of frequencies for the TCU LoA range show a fairly equal distribution between those teachers in terrestrial community broadband and satellite community broadband availability with approximately 60-80% of teachers in Level 2 and 3 TCU LoA range as shown in Table 41.

Table 41

Teacher Classroom Use LoA

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Level 1 LoA	9	32.1%	6	30.0%	5	10.9%
Level 2 LoA	7	25.0%	9	45.0%	26	56.5%
Level 3 LoA	10	35.7%	5	25.0%	13	28.3%
Level 4 LoA	2	7.1%	0	0.0%	2	4.3%
Total N	28	100.0%	20	100.0%	46	100.0%

4.4.9 Teacher creation of online resources for students.

Teachers were asked if they created online resources for their students to use at home. Pearson's Chi-Square was used to investigate the distribution of nominal, categorical data to answer the question regarding teachers' creation of online learning resources for home use by students.

Research Question 9: Does access to broadband in the home make a difference as to whether teachers create online learning resources for students to extend the learning day requiring internet access at home?

1. Null Hypothesis H_0: There is no difference as to whether teachers create online learning resources for students to extend the learning day requiring internet access at home, given the three categories of community broadband availability.

2. Alternate Hypothesis H_1: There is a difference as to whether teachers create online learning resources for students to extend the learning day requiring internet access at home, given the three categories of community broadband availability.

There was a significant difference among teachers who create online learning resources for students to extend the learning day compared across three categories of community broadband availability, as reported using Pearson's Chi Square, ($\chi^2(2, N=94) = 13.539, p=<.001$). Approximately 80% of the teachers in communities with no access to broadband do not create online resources, compared to almost 65% of teachers in terrestrial community broadband availability and almost half of the teacher in satellite broadband availability categories that do create online learning resources for students. Therefore, the null hypothesis is rejected, since in fact there is a difference in teachers creating online learning resources based on community broadband availability. The distribution of frequencies is shown in Table 42.

Table 42

Online Resources for Students to Use at Home

Comparison based on Community Broadband Availability						
	Terrestrial		Satellite		No Broadband	
I create lessons using online resources for my students to use at home.	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	18	64.3%	9	45.0%	10	21.7%
No	10	35.7%	11	55.0%	36	78.3%
Total N	28	100.0%	20	100.0%	46	100.0%

4.5 Qualitative Findings

Open-ended questions, retrieved from the surveys for teachers and students were categorically coded into themes, to further illuminate the results of the above research questions, and provide additional data not available quantitatively allowing the researcher to create a more well rounded picture. Each question was transcribed from the original survey, and transcriptions were shared with Robert Whicker, cohort member. Both Whicker (2012) and Lloyd reviewed transcriptions and created categories based on responses, which were then turned into major themes. Validation of themes occurred between Whicker and Lloyd for reliability of categories and themes (Whicker, 2012). The open-ended questions used for this study include two teacher questions and two student questions.

4.5.1 Teacher response to open-ended questions.

Teachers were asked to respond to the question referencing the best reason for pursuing a one-to-one laptop program. Responses from 72 teachers provided a total of 82 open codes that contributed to categorical themes. The majority of the responses revealed teachers' perceptions for implementing a one-to-one laptop program important for student learning, especially in areas for higher order thinking strategies for learning. Student readiness in the workforce also had high frequency of responses in that technology played an important role for workforce development and aided students in getting a job. Teachers had strong beliefs that student access on online resources was a high priority for pursing a one-to-one laptop program, especially for extending the learning day, even though quantitative findings for teachers in communities with no broadband access were less likely to create online learning resources for students to extend the learning day. In addition, like many previous studies (Bebell & Kay, 2010; H. J. Becker, 2000a; Metiri Group & The University of Calgary, 2009), student engagement ranked high in teachers' responses. Categorical themes for reasons for pursuing a one-to-one laptop program are shown in Table 43.

Table 43

Teacher Response to Pursuing a One-to-One Laptop Program

Teacher Question: What is the best reason for pursuing a one-to-one laptop program n=72

Categorical Theme	Frequency	Sub-Categories Codes	Frequency	Sub-Categories Codes	Frequency
Student readiness for workforce –	14	Technology focus for Technology workforce	5	Workforce development	9
Access for Students	22	Resources	17	Opportunities	1
		Equity	2	Efficiencies for Students	2
Student learning outcomes from one-to-one laptop program	25	Higher order thinking skills	10	Demonstrated learning in new ways	2
		Quality of work increased	1	Provides relevant learning	2
		Learning process through content	8	Creativity	2
Student Engagement	15	Engagement	5	Student life	10
Teacher Impacts	6	Teaching effectiveness	4	Teacher access to resources	2

Teachers were asked, "What is the learning activity you are most proud of that you have used with students?" The majority of responses reflected ways of learning or ways students demonstrated their learning. Most of the learning demonstrated was in the area of students producing reports or presentations. The second most frequent use of technology learning activities was using technology like wikis, blogs, and internet Web Quests as part of a learning activity for students. The majority of these activities would fall under lower levels of use in the TCU LoA complexity questions. Coding and themes are shown in Table 44.

Table 44

Teacher Response to Learning Activities in the Classroom

Teacher Question: What is the learning activity you are most proud of that you have used with students?									N=63
Categorical Themes	F	Category Codes	F	Category Codes	F	Category Codes	F	Category Codes	F
Students' Demonstrated Learning	30	Word Processing	4	Presentation Applications	18	Podcasts or video editing	4	Comic builder application	4
Using Technology for Learning Activities	19	Learning Applications	8	Web quests – internet projects	3	Wikis or Blogs	8		

4.5.2 Student response to open-ended questions.

Students were asked to respond to the question referencing the best reason for having a laptop in a one-to-one laptop program. Access to the internet for both schoolwork and homework were important with the majority of students in category 1 of broadband availability via terrestrial delivery having the highest frequency for using the internet for homework. Across all three categories of community broadband availability, students believed it was important to have a laptop for information, research, and communication. Interestingly, the students in the category of no broadband access available were the only group that believed the laptop was important for learning skills. Categorical themes for laptop importance as identified by students' perceptions are shown in Table 45.

Table 45

Student Response to Laptop Importance

Student: Give one reason why you think having a laptop is important			N=697	
Categorical Themes	Total Theme Frequency	Category 1: Terrestrial Broadband Access Available in Community	Category 2: Satellite Broadband Access Available in Community	Category 3: Broadband Access not Available in Community
		Frequency	Frequency	Frequency
Productivity to include word processing, typing programs, and presentations	239	63	26	150
Schoolwork	128	48	16	64
Homework	93	46	13	34
Internet Access	163	72	18	73
Organization	39	17	3	19
Mobility	9	7	2	0
Information or Research	174	61	23	80
Communication or Social	38	14	5	19
Understanding Global World	3	3	0	0
Not having to share a computer	6	0	0	6
Skills	23	0	0	23

Students were asked to give one reason why having a laptop may not be a good idea. Open coding revealed similar themes across all categories of community broadband availability. The majority of responses believed that inappropriate laptop use during the school day, including social networking and online gaming to be the biggest culprits for inappropriate use. Secondly, students believed that distractions and off-task behaviors created an environment where students were non-productive. A large number of students in the category of no broadband available felt that the laptop was not a bad idea, while students across all three categories of community broadband availability believed abuse of resources was the number one reason that having a laptop was a bad idea. The majority of the responses revealed students' perceptions for having a laptop important for productivity and presentations that is aligned with the teacher responses in Table 46.

Categorical themes showing why a laptop may be a bad idea as identified by students is shown in Table 46.

Table 46

Student Response to Why Laptop may be a Bad Idea

Student Response: Give one reason why you think having a laptop might be a bad idea?					N=691
Categorical Theme	Theme Frequency Total	Codes	Terrestrial Broadband Available in Community	Satellite Broadband Available in Community	No Broadband Access Available in Community
			Frequency	Frequency	Frequency
Non-Productivity	151	Distraction	49	13	32
		Wastes Time	1	0	0
		Off-Task	17	4	36
Inappropriate use during school day	301	Social Networking Sites	33	14	88
		Online gaming	41	12	40
		Inappropriate	44	10	19
Laptop policy violations	23	Hacking to bypass school filters	8	5	6
		Cheating	3	1	0
Abusing Resources	47	Bandwidth	3	0	1
		Equipment Abuse	17	10	16
Health Concerns	8	Bad for Eyes	6	0	2
It's Not a Bad Idea	151	Don't believe it's a bad idea	28	26	97

4.6 Chapter Summary

Chapter four presented the results from both quantitative and qualitative analysis of data. Quantitative data analysis comprised of several statistical tests produced results for nine research questions. In addition, chi-square and cross tabs were used to provide descriptive distribution of frequencies for demographics in both student and teacher surveys. One-way ANOVAs were used to provide results for continuous data comparing three categories of community broadband availability to answer the research questions for this study. Qualitative analysis of open-ended questions, coupled with focus group responses from students, provided a more complete picture of the digital divide in Alaska's one-to-one laptop implementations.

Chapter 5: Conclusions

The research for this study was designed to provide a broader picture of the implementation of one-to-one laptops across Alaska's high schools with the specific purpose to measure the difference in personal and classroom use levels of adoption given three categories of community broadband availability. This final chapter provides an overview of the demographics for teachers and students, as well as key findings for each of the research questions, limitations of the study, and recommendations for further studies.

5.1 Summary of Findings

Descriptive statistics using cross-tabs with frequency distributions provide an understanding of the demographic data for teachers and students, given three categories of community broadband availability. In addition, quantitative analysis using Pearson's Chi-Square and one-way ANOVA provided results that were presented in Chapter four for nine research questions. Qualitative data was analyzed using open-coding methods to create themes that were used to complement the quantitative data and to illuminate the findings. A summary of key findings is presented below.

5.1.1 Teacher demographics.

Overall the teacher sample compared across the three categories of broadband availability had similar demographics with approximately 25%-35% of the teachers falling in the category of 30-39 years of age, and approximately 25%-32% of the teachers falling in the 50-59 years of age category.

Teacher tenure was consistent across all three categories of community broadband availability, in that the majority of teachers within each category had the highest number of teachers with 11 or more years of experience. Teacher tenure in the category of terrestrial broadband availability had the highest percentage with 75% of the teachers having 11 or more years of teaching, while teacher tenure in the satellite community broadband and no broadband available categories had approximately 45% of the teachers with 11 or more years of teaching experience.

Teacher tenure in the one-to-one laptop school showed the highest number of teachers with 64% of the teachers in communities with terrestrial broadband availability, and 40% of the teachers in communities with satellite broadband availability having 5 or more years in their current school. Teachers in communities with no broadband available had the highest percentage with 41% of the teachers having 3-4 years of experience in their current school. It is no surprise that teacher tenure in school communities with no broadband access have the lowest percentage among the three categories of broadband availability. Teacher turnover has long been an ongoing barrier for rural schools in Alaska (Hirshberg & Hill, 2006).

Teacher tenure in a one-to-one laptop school showed approximately two-thirds of the sample distribution of teachers as having three or more years of experience in a one-to-one laptop program. Within each of the three categories of community broadband availability, the majority of teachers have been teaching in a one-to-one laptop program for three or more years, with higher percentages of teachers, 40% of teachers in both terrestrial and satellite broadband availability having five or more years teaching experience in a one-to-one laptop program. This compared to 17% of the teachers in communities with no broadband availability having five or more years teaching experience.

Key differences among the teachers in the three categories of community broadband availability were notable, and included professional development hours and home internet access. The distribution of frequencies showed a disparity between the three categories of community broadband availability, with 71% of the teachers living in communities with no broadband availability having the least number (8 hours or less) of professional development hours provided by the school district. This compared to 30% of the teachers in communities with satellite broadband availability, and 15% of the teachers in terrestrial community broadband availability having 8 hours or less of professional development provided by the school district. Teachers in communities with terrestrial broadband availability had the highest percentage of teachers (over two-thirds) responding they received over 40 hours of professional development from their school district. This same trend was also captured in the number of hours of professional development outside of the school day, where teachers in the terrestrial community broadband availability category had the largest percentage with almost 50% of the teachers responding with more than 27 hours of courses and classes beyond the school day, as compared to those teachers in the community without broadband access having the highest percentage with 64% of teachers with no hours of professional development beyond the school day. Although disparities in professional development were reported in the number of hours spent beyond the school day and during the school day, teachers across all three categories of community broadband availability rated themselves as either intermediate or experienced on a four-point scale from beginner to expert, with satellite and no broadband available having the highest percentages with 60% and 46% of the teachers rating themselves as experienced, compared to 40% of the teachers living in the terrestrial broadband availability communities.

Lastly, the largest number of teachers without access to the internet in their home was found in the communities where broadband was not available, where 35% of the teacher population identified themselves as not having broadband access compared to 5% of those teachers living in communities with terrestrial broadband availability.

5.1.2 Student demographics.

The student population across the three categories of community broadband availability resulted with a wider spread of age, with students ranging from 12-19 years of age in the no broadband category. Student age groups in terrestrial and satellite were distributed evenly across 14-18 years of age. The wide spread in age group for the no broadband available communities may be due to the small population of rural schools and the need to create multi-age classrooms.

Key differences among students in the three categories of broadband availability were found in tenure in the school, ethnicity, and access to the internet at home. Students in communities where terrestrial broadband was available were predominantly white (70%) of students, while the other two communities had 45% of the students in communities with satellite broadband availability, and 90% of the students in no broadband availability communities self identified themselves as predominantly Alaska Native. Unlike teacher demographics, student groups also differed in the number of years in their current school, with the students in communities where broadband is not available having the longest longevity in the school, with 67% of the students responding they had 6 or more years in their current school. The majority of students in both terrestrial and satellite broadband availability reported over half of the students were in their current school for two years or less. In addition, students in communities where terrestrial broadband was available had the highest percentage with almost 40% of students with less than one year in their current school.

The results for student tenure in their current school reflects the number of years in a one-to-one laptop program, with almost half of the students living in the community with no broadband availability, and a third of the students living in communities with satellite broadband availability reporting they 3-4 years experience in a one-to-one laptop program. This compares to 35% of the students living in terrestrial broadband availability having less than one year of experience in a one-to-one laptop program. Although there were significant differences in the years of experience in one-to-one laptop programs, the majority of students rated themselves as either intermediate or experienced across all three categories of broadband availability.

5.1.3 Student and teacher perceptions of use.

Students and teachers were asked questions regarding laptop home use and internet access. Teacher and student perceptions regarding broadband in the home provide a broader picture to illuminate the findings in this study. Teachers and students were asked if they had internet access in their home. Approximately one-third of the teachers and students living in communities with no broadband available responded that they did not have internet access in their home, compared to 2% to 5% of the students and 7% to 15% of the teachers living in communities with broadband availability stating they did not have internet access in their home. Student focus groups conducted in each of the three categories of broadband availability confirmed the lack of internet access as well as perceived speeds of bandwidth available within each community of broadband availability.

Students' belief that internet makes them a better student provided varied responses between those students living in communities with broadband availability and those that lived in communities with no broadband access. Students living in communities with broadband access whether it be satellite or terrestrial, had favorable responses with approximately 70% of the students responding that they believe having internet access at home makes them a better student. This compared to 40% of the students living in communities with no broadband available responding that they believed having internet access at home made them a better student.

Student use of personally owned computers compared across the three categories of broadband availability showed similar results. Students living in communities with terrestrial broadband availability reported 79% of the student population having a personal computer at home and 88% of the students living in communities with broadband available via satellite identified themselves as having a personal computer at home. In contrast, those students living in communities with no broadband access showed a little over half of the students identifying themselves as having a personal computer at home.

There was no significant difference in students' use of laptop at home for schoolwork, with 80% to 90% of the students in all three categories of broadband availability responding that they used their laptops at home for schoolwork. In contrast, teachers' perceptions regarding students' use of laptops at home for schoolwork showed differing results. Approximately three-fourths of the teachers living in communities with terrestrial broadband availability believed their students used their laptops for schoolwork. Less than half of the teachers living in communities with satellite broadband availability perceived their students used the laptop for schoolwork. There was a large contrast in student response and teacher beliefs about student use of laptops for schoolwork at home in communities with no broadband available. Less than one-fourth of the teachers believed their students used their laptops for schoolwork at home, when almost 80% of the students responded they did use their laptop at home for schoolwork.

There were differences in home access for students compared across the three categories of broadband availability. Students in communities where broadband is not available had the highest percentage, with 31% of students without access to the internet at home compared to 5% of the students living in communities with terrestrial broadband availability and 2% of the student living in communities with satellite broadband availability. Student use of personally owned computers compared across the three categories of broadband availability showed similar results for students living in communities with terrestrial broadband availability reporting 79% of the student population having a personal computer at home and 88% of the students living in communities with broadband available via satellite identified themselves as having a personal computer at home. In contrast, those students living in communities with no broadband access showed only 56% of the students identified as having a personal computer at home.

Three-fourths of students in communities where broadband is available either through terrestrial or satellite delivered broadband, felt that the internet made them a better student. When answers to this question included "maybe" and "yes" responses, combined, the responses across all three categories were between 80% and 90% favorable in the belief that having internet at home makes them a better student.

5.2 Discussion of Results

This section summarizes the results from the investigative questions that support the overarching question "Does broadband availability in a school community have an impact on the teaching and learning experience for teachers and students in a one-to-one laptop program?" The results for nine investigative research questions are below.

5.2.1 Research question one.

Does access to broadband in the home make a difference in the amount of time students spent using the laptop for home use?

There was no significant difference between students living in communities with broadband availability, whether is was terrestrial or satellite delivery in the number of hours spent using the laptop for home use. There was a significant difference in the number of hours spent using the laptop for home use between students living in communities with no broadband availability as compared to the other two groups. Students living in communities with satellite broadband availability actually had the highest percentage 44% of students spending 3 or more hours per day for home use, compared to 38% of the students living in communities with terrestrial broadband availability.

5.2.2 Research question two.

Does access to broadband in the home make a difference in the amount of time students spent using the laptop for schoolwork?

While the general home use showed significant differences between the three categories of broadband availability, there was no significant difference in the amount of time spent using the laptop for schoolwork between the three groups. Ninety percent of the students across all three categories of broadband availability identified the number of hours spent using the laptop for schoolwork as less than 3 hours per day.

Student use of the laptop for schoolwork at home compared across three categories of broadband availability showed higher numbers, with approximately 90-95% of students in communities with terrestrial and satellite broadband delivery as using their laptop at home for schoolwork. Students living in communities with no broadband availability resulted in 79% of the students using their laptop at home for schoolwork. In contrast, teacher perception of student use of laptop at home for schoolwork was not consistent with student identified use.

Teachers living in communities with terrestrial broadband availability had the highest percentage, with 71% of the teachers believing their students used their laptop for schoolwork, compared to 45% of the teachers living in communities with satellite broadband availability, and 24% of the teachers living in communities with no broadband access. Teacher perceptions were not congruent with student actual responses for laptop use at home for schoolwork.

5.2.3 Research question three.

Does access to broadband in the home make a difference in SPU LoA?

Student personal use consisted of frequency of use as well as proficiency in applications, including the use of email, blogs, social networks, photo and/or video sharing, social bookmarking, RSS feeds, online productivity tools, instant messaging, internet browsing, and research. There was a significant difference in SPU LoA between students living in communities with no broadband availability compared to students living in communities with broadband availability whether it was satellite or terrestrial. There was no significant difference between students living in communities with broadband via terrestrial and satellite. The majority of students living in communities with no broadband availability rated their personal use in level 1 and 2 of technology adoption, whereas the majority of students living in terrestrial or satellite broadband availability communities rated themselves in personal use in level 2 and 3 for technology adoption.

5.2.4 Research question four.

Does access to broadband in the home make a difference in SCU LoA?

Student classroom use consisted of frequency of use as well as proficiency in applications, including the use of email, drill and practice, web based testing, internet research, spreadsheets, databases, sound editing, photo/video sharing, social networking, and presentation software in the classroom. There was no significant difference between the SCU LoA across all three categories of community broadband availability. Students across all three categories had the highest percentages of students rating themselves as level 1 and 2 in SCU LoA. Students living in communities with terrestrial broadband availability had the highest percentage, with 54% of students identified in Level 2, as did 41% of the students living in communities with no broadband availability. Students living in communities with satellite broadband availability had the highest percentage, with 47% of students as self identified in level 1 for technology adoption in the classroom.

5.2.5 Research question five.

Does access to broadband in the home make a difference as to whether teachers assign homework that requires internet access at home?

Students were asked if teachers required internet access for homework assigned, as well as which subject areas required internet access at home. There was a significant difference in the responses between students living in communities with no broadband access and students living in communities with broadband, whether it was delivered over satellite or terrestrial transport.

Students living in communities with no broadband availability resulted in half of the students stating teachers did not assign homework that required internet access at home. In contrast, close to 80% of the students living in communities with terrestrial broadband availability and 65% of the students living in communities with satellite broadband availability responded positively that teachers assigned homework that required internet access at home. This difference may be in part due to the high percentage of students living in communities with no broadband available that stated they do not have internet in their home. It could also reflect the perceptions that teachers had in reference to students' use of laptop at home for schoolwork.

5.2.6 Research question six.

Does access to broadband in the home make a difference in the amount of time teachers spent using the laptop for home use?

Teachers were asked how many hours per day they used their laptop at home. There were 24 teachers that did not have internet access at home. The results showed no significant difference in the amount of time teachers used their laptops for home use, compared across the three categories of community broadband availability. Interestingly, teachers living in communities with no broadband available had almost 25% of the teachers stating they used their laptop on the internet at home for more than three hours per day, compared to only 15% of those teachers living in terrestrial broadband available communities. This may in part be due to the isolation in some of the rural school communities.

5.2.7 Research question seven.

Does access to broadband in the home make a difference in the TPU LoA?

Levels of Adoption (LoA) for teachers were developed using various questions about the use of applications and technologies in the classroom. There was no significant difference in TPU LoA among teachers living in three communities of broadband availability. Teachers living in communities with terrestrial broadband availability were the only group to fall in Level 4 of the TPU LoA, compared to teachers living in communities with terrestrial and no broadband available falling into Level 4 for TCU LoA.

5.2.8 Research question eight.

Does access to broadband in the home make a difference in TCU LoA?

Teachers' classroom use LoA resulted in no significant difference compared across three categories of community broadband availability. Results for TCU LoA were congruent with results from TPU LoA in that over three-fourths of teachers across all categories of community broadband availability were spread evenly across Level 2 and Level 3 in TPU LoA.

Key differences however, between TPU LoA and TCU LoA compared across three categories of community broadband availability show teachers in communities with no broadband availability falling into higher levels for classroom use as compared to personal use. This was not the case with teachers living in communities with broadband availability, whereas, these teachers had higher percentages in personal use than classroom use LoAs. This difference between TPU LoA and TCU LoA may be due to the discrepancy in the number of professional development hours compared among the three categories of community broadband availability. Teachers living in communities with no broadband available have less hours of professional development than teachers living in communities with broadband available.

5.2.9 Research question nine.

Does access to broadband in the home make a difference as to whether teachers create online resources for students to extend the learning day requiring internet access at home?

Teachers were asked if they created online resources that required internet access for students to use at home to extend their learning day. There was a significant difference in teachers creating online resources for their students compared across the three categories of community broadband availability. While 65% of the teachers living in terrestrial communities of broadband availability created online lessons for their students, only about 20% of the teachers in communities with no broadband access created lessons for their students. This compared to almost half of the teachers living in communities with satellite broadband availability.

These results are not surprising, given the percentage of teachers and students having no internet available that live in communities with no broadband access. However, these results show inequities for students living in communities with no broadband access compared to students living in communities with broadband.

5.3 Qualitative Findings

Teachers were asked why it was important to pursue a one-to-one laptop program. The majority of responses revealed that teachers believed the most important reason for pursuing a one-to-one laptop program was to promote higher order thinking strategies for student learning. Ensuring student readiness for the workforce and helping students get jobs was second in importance. Teachers also believed that student access to online resources was a high priority, especially to extend the learning day. While teachers believed access to online resources was a priority, there was a discrepancy in quantitative findings showing that teachers living in communities with no broadband access had a higher percentage that did not create online resources for their students. This may be due to the availability and quality of internet access for students and teachers living in communities with no broadband access.

Teachers were also asked which learning activity using laptops with students, made them most proud. The majority of teacher responses revealed the ways in which students demonstrated or presented their learning, either through presentation applications or word processing. The learning activities identified in the open-ended question were based on applications and uses that were weighted as a lower level of use within the TCU LoA. This provides an explanation as to why the majority of teachers fell within Level 2 and 3, with very few teachers in Level 4 LoA.

Students were asked what was the best reason for implementing a one-to-one laptop program and why an implementation might be a bad idea. Student responses were compared across the three categories of broadband availability. The majority of responses revealed students' belief that the laptop was important for productivity and presentations. These responses were congruent with teacher open-ended question responses above.

Access to the internet for both schoolwork and homework were rated high among students in all categories of broadband availability. However, the highest frequency of responses in using the internet for homework came from students living in communities with terrestrial broadband availability.

Students from all three categories of community broadband availability believed it was important to have the laptop for research, information, and communication. Interestingly, the only group of students that believed the laptop was important for learning skills was students in the category with no broadband access available. Research supports this finding in that students in communities without internet access were given more drill and practice kinds of applications than students from schools that had internet access in the home (H. J. Becker, 2000a). This response also supports reasons why TCU LoA was significantly different compared across the three categories of broadband availability, as skill applications were weighted lower for the TCU index.

The majority of students in communities with no broadband access believed that inappropriate use, including using the laptop for social networking and online gaming during the school day was the biggest distraction for teaching and learning with 88 responses compared to 47 responses from students in communities with broadband availability. While social networking and gaming sites are generally blocked at school, students are continually finding proxies and other ways to bypass the content filters. The fact that more students living in communities with no broadband access are using social networking sites and gaming during the school day may be in part due to the lack of broadband at home.

5.4 Limitations to the Study

The conclusions in this study are based on data analyzed from a sample of students and teachers in Alaska's one-to-one laptop programs. It is important to address the assumptions that were made in the context of this research in order to fully understand the limitations and implications. This study was developed with the assumption there was a defined criteria to provide consistency within the population studied. This common definition included high school teachers and students who were participants in a one-to-one laptop program for a minimum of one year. The one-to-one laptop program used defined criteria that provided a complete solution. The defined complete solution included professional development, technical services including wireless infrastructure, common software applications, and policies in place for students to take the laptop home to extend the learning day.

While the entire sample population met the required criteria for a complete solution in this study, it is important to note the differences between the sample groups of students and teachers within the context of the three communities of broadband availability. The majority of one-to-one complete solution implementations occurred in rural Alaska, in communities with no broadband availability. These communities have no road access to villages or towns, and a population that is mostly Alaska Native and live on subsistence. Communities with satellite broadband available have a larger population to support the high cost of broadband over satellite, with more economic potential with a developed workforce. Those communities with terrestrial broadband availability in this study would also be considered rural, as many of the communities have no road access; however, they have a greater population than those communities in satellite hubs, and they are connected to fiber optic systems connecting Petersburg, Wrangell, and Juneau to Seattle.

The surveys for this study provided a comprehensive data set; however, there were factors in this study that were not addressed within the survey questions. The speed and size of the bandwidth pipe for classroom use would have provided a better comparison ratio of user to broadband within each of the three categories of broadband availability. In addition, survey questions for teachers and students that addressed the specific internet provider used would have provided further verification for the internet services offered within each community with actual speeds for each participant in the study. This information will be useful in further studies that address comparisons for levels of use and adoption within varied broadband availability.

Each of the districts that implemented one-to-one laptop programs at the beginning of this study may have initiated policies that are different than the original requirements for the defined criteria. Changes in leadership may have affected the consistency of the defined criteria and policies including the ability to take the laptop home.

The vastness of Alaska's geography, combined with the cultural diversity in each of the communities provide differences that need to be addressed when making generalizations of the findings within this study. Considerations for socioeconomic conditions and culture within the communities create variables that were not addressed in the context of this study. The unique conditions within each of these communities in this study create inconsistencies in implementation and present opportunities for further study.

5.5 Implications for Further Study

This research, combined with the research of the three cohort studies presents key findings for one-to-one laptop implementations in Alaska (Ledoux, 2012; Standley, 2012; Whicker, 2012). The knowledge gained from each of these mixed method studies provides for a larger picture that includes teaching styles, teacher concerns, teacher and student LoA, and student voices in Alaska's high school one-to-one laptop programs.

The evidence from this study suggests that there are differences in student LoA in personal and classroom use given broadband availability. It would be of interest to conduct a similar study using SPU LoA and SCU LoA with the communities that are part of the TERRA SW project.

Beginning in August 2012, TERRA SW will provide 65 communities with terrestrial broadband for consumers in the home. Of the 65 communities, 16 communities in the no broadband access category will have terrestrial broadband available by the end of 2012. This comparison study could provide more information as to whether or not broadband in the home makes a difference in LoA for personal and classroom use.

More in-depth research might explore or investigate the LoA used in this study to validate the LoA for classroom and personal use as it pertains to complexity of applications and use. This analysis could provide teachers and administrators with tools to focus professional development. Further research is warranted to look more closely at how personal use impacts classroom use for students and teachers.

5.6 Summary

This study set out to determine if access to broadband in the community has an impact on the teaching and learning experience for teachers and students in high school one-to-one laptop programs. Overall, there was no significant difference found in teachers personal or classroom use as defined by LoA indices. However, results from the analysis of student data revealed significant differences in personal and classroom use LoA for students living in communities with no broadband available compared across the three categories of broadband availability. Students living in communities with no broadband access had lower mean scores compared to students living in communities with broadband, whether it was delivered via satellite or terrestrial transport. This difference was present, even with students living in communities with no broadband having more years experience in the one-to-one laptop program than students living in communities with terrestrial broadband. Interestingly, there was not a significant difference between students living in communities with broadband available whether it was delivered via satellite or terrestrial transport.

One of the more significant findings to emerge from this study is the difference in teacher expectations compared across the three categories of broadband availability in reference to expectations for students' use of the laptop at home for schoolwork and the creation of online resources for students to extend the learning day. In both scenarios, teachers living in communities with no broadband access had lower expectations in both of these areas for their students than those teachers living in communities with broadband availability.

In summary, this research will serve as a base for future studies to take a closer look at the digital divide and the implications for students in rural areas where broadband is not available. These communities have been labeled un-served by the FCC, (Federal Communication Commission, 2010). The communities identified in this study with no broadband available represent the FCC labeled un-served population. The fact that 90% of the students living in these communities are Alaska Native should in itself create an urgency to further the development of broadband for rural Alaska. Schools across Alaska have invested in education technology to create a level playing field for their students. It is time for Alaska to implement a plan to bring broadband to all of Alaska's students, no matter their ZIP code.

References

Alaska Department of Education and Early Development. (2010). Report Card to the Public, from http://eed.state.ak.us/DOE_Rolodex/schools/ReportCard/RCSearch.cfm

Allen, S. R., & Wince-Smith, D. (2011). Making impact: raising the competitive bar for America: Council of Competitiveness.

Anderson, R. E., & Becker, H. J. (2001). School investments in instructional technology. Irvine: Teaching, Learning, and Computing: 1998 National Survey.

Apple Computer Inc. (2005). Research: What It says about 1 to 1 learning.

Argueta, R., Huff, J., Tingen, J., & Corn, J. O. (2011). Laptop Initiatives: Summary of research across six states (Vol. 4): The Friday Institute.

Association of Alaska School Boards. (2006). Consortium for Digital Learning Retrieved 05/20/2010, 2010, from http://web.mac.com/aasb.cdl/Consortium_for_Digital_Learning/Home_Page.html

Attewell, P., & Battle, J. (1999). Home computers and school performance. *The Information Society, 15*(1-10).

Attewell, P., Suazo-Garcia, B., & Battle, J. (2003). Computers and young children: social benefit or social problem? *Social Forces, 82*(1), 277-296.

Atwater, S. G. (2008). *A description of the relationship between process management and the Quality Schools Model in three rural Alaska school districts.* Doctoral dissertation, University of Alaska Fairbanks, Fairbanks.

Barnette, B. G., & Muth, R. (2008). Using action-research strategies and cohort structures to ensure research competence for practitioner-scholar leaders. *Journal of Research on Leadership Education, 3*(I).

Barrios, T., Ambler, J., Anderson, A., Barton, P., Burnette, S., Gallup, J. (2004). Laptops for learning: Final report and recommendations of the laptops for learning task force: Department of Education, State of Florida.

Beaudry, J. (2004). The impact of Maine's one-to-one laptop program on middle school teachers and students: Maine Education Policy Research Institute.

Bebell, D., & Kay, R. (2009). Berkshire Wireless Learning Initiative: Final evaluation report. Chestnut Hill: inTASC Technology and Assessment Study Collaborative.

Bebell, D., & Kay, R. (2010). One to one computing: A summary of the quantitative results from Berkshire Wireless Learning Initiative. *The Journal of Technology, Learning, and Assessment, 9*(2), 1-60.

Becker, H. J. (1999). Internet use by teachers: Conditions of professional use and teacher-directed student use. Irvine: Center for Research on Information Technology and Organizations.

Becker, H. J. (2000a). Pedagogical motivations for student computer use that lead to student engagement. *Educational Technology*.

Becker, H. J. (2000b). Who's wired and who's not: Children's access to and use of computer technology. *The Future of Children, 10*(2), 44-75.

Becker, H. J., & Ravitz, J. (2001). *Computer use by teachers: Are Cuban's predications correct?* Paper presented at the American Educational Research Association, Seattle.

Becker, J. D. (2006). Digital equity in education: A multilevel examination of differences in and relationships between computer access, computer use and State-level technology policies. *Education Policy Analysis Archives, 15*(3).

Beltran, D., Das, K., & Fairlie, R. W. (2006). *Are computers good for children? The effects of home computers on educational outcomes*. New York: William T. Grant Foundation.

Blessing, L. T. M., Chakrabarti, A., & Wallace, K. M. (1998). *DRM, A Design Research Methodology*. London: Springer.

Blood, R. (2000). Weblogs: A history and perspective

Bonifaz, A., & Zucker, A. (2004). Lessons learned about providing laptops for all students: Northeast and the Islands Regional Technology in Education Consortium.

Boote, D. N., & Belle, P. (2005). Scholars before researchers: On the centrality of the dissertation literature review in research presentation. *Educational Researcher, 34*(6), 3-15.

Brien, S. J. (1992). *The adult professional as graduate student: A case study in recruitment, persistence, and perceived quality.*, MI, Ann Arbor.

Bryman, A. (1999). *Triangulation.* Loughborough, Leicestershire.

Caperton, G., & Papert, S. (1999). *Vision for Education: The Caperton-Papert Platform.* Paper presented at the 91st Annual National Governors' Association meeting, St. Louis.

Carroll, J. B. (1963). A model of school learning. *Teachers College Record, 64*, 723-733.

Carroll, J. B. (1989). The Carroll Model: A 26-year retrospective and prospective view. *Educational Researcher, 18*(1), 26-31.

Cavanaugh, C., Dawson, K., & Ritzhaupt, A. (2008). *Statewide study of 1:1 computing: The impact on teaching and achievement.* Paper presented at the National Education Computing Conference, San Antonio.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through quantitative analysis*. Los Angeles: Sage.

Chun, M. (2010). Taking teaching to performance task: Linking pedagogical and assessment practices. *Change, 42*(2), 22-29.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2008). Scaling the digital divide: Home computer technology and student achievement. Durham: Duke University.

Compaine, B. M. (2001). *Information Gaps: Myth or Reality?* . Cumberland, RI: MIT Press.

Connect Alaska. (2010). Connect Alaska: Residential Technology Assessment Results Key Findings. Juneau: Connected Nation.

Connect Alaska. (2011). Trends in Alaskan residential technology adoption: Connect Alaska.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: design & analysis issues for field settings*. Chicago: Rand McNally.

Cooper, K., & Gallagher, M. (2004). *A nation online: Entering the broadband age*. Washington DC.

Cope, D. L. N. (2008). *The Quality Schools Model of education reform: A description of knowledge management beliefs and practices using Baldridge in education criteria.* Doctoral dissertation, University of Alaska Fairbanks, Fairbanks.

Corn, J. O. (2009). Evaluation Report on the Progress of the North Carolina 1:1 Learning Technology Initiative (Year 2). Raleigh: Institute for Educational Innovation.

Creamer, E. G. (2004). Collaborators' attitudes about differences of opinion. *The Journal of Higher Education, 75*(5), 556-571.

Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches*. Thousand Oaks: Sage Publications, Inc.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks: Sage Publications, Inc.

Crumley, R. L. (2008). *A description of Baldridge in education leadership Concepts within the Alaska Quality Schools Model of Education.* Doctoral dissertation, University of Alaska Fairbanks, Fairbanks.

Cuban, L. (2001). *Oversold & underused: Computers in the classroom*: President and Fellows of Harvard College.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in hIgh school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.

Culp, K. M., Honey, M., & Mandinach, E. (2003). A retrospect on twenty years of education technology policy. In O. o. E. T. U.S. Department of Education (Ed.). Washington DC.

Dalgarno, N. J. (2009). *Compulsory laptop programs: Teachers' responses to the adoption and implementation process.* Doctor of Philosophy, Queen's University, Kingston, Ontario, Canada.

Dawson, K., Cavanaugh, C., & Ritzhaupt, A. (2006). Florida's EETT leveraging laptops initiative and its impact on teaching practices. *Journal of Research on Technology in Education, 4*(2), 143-159.

DeBell, M., & Chapman, C. (2003). *Computer and internet use by children and adolescents in 2001*. Washington DC.

Denzin, N. K. (1970). *The Research Act in Sociology*. Chicago: Aldine.

Dickard, N. (2002). Federal retrenchment on the digital divide: Potential national impact. Washington DC: Benton Foundation.

Dickard, N. (2003). The sustainability challenge: Taking ed-tech to the next level. Washington DC: The Benton Foundation Communications Policy & EDC Center for Children and Technology.

Dickes, L. A., Lamie, R. D., & Whitacre, B. E. (2011). The struggle for broadband in rural America. *Agricultural and Applied Economics Association*.

Dijk, J. V. (2000). *The Ideology Behind Closing Digital Divides: Applying Static Analysis to Dynamic Gaps*. Paper presented at the IAMCR and ICA Symposium on the Digital Divide, Austin, Texas.

DiMaggio, P., Hargittai, E., Celeste, C., & Shafer, S. (2004). *Digital Inequality: From Unequal Access to Differentiated Use*. New York: Russell Sage Foundation.

Dorn, S., & Papalewis, R. (1997). *Improving doctoral student retention*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, Illinois.

Dorn, S., Papalewis, R., & Brown, R. (1995). Educators earning their doctorates: Doctoral student perceptions regarding cohesiveness and persistence. *Education Policy Analysis Archives, 116*, 305-314.

Du, J., Harvard, B., Yu, C., & Adams, J. (2004). The impact of technology on low-income minority students' academic achievement: Educational longitudinal study of 2002. *Journal of Educational Research & Policy Studies, 4*(2), 21-38.

Dwyer, D., Ringstaff, C., & Sandholtz, J. H. (1991). Changes in teachers' beliefs and practices in technology-rich classrooms. *Education Leadership, 48*(8), 45-52.

Edwin, J., Hirshberg, D., & Hill, A. (2009). Consortium for digital learning project: Association of Alaska School Boards mid-term progress report. Anchorage: Institute of Social and Economic Research.

Elementary and Secondary Education Act. (2001). *No Child Left Behind Act of 2001*. Washington DC: Retrieved from http://www.ed.gov/policy/elsec/leg/esea02/index.html.

Encyclopedia Britannica, I. (2007) (April 10, 2008 ed. ed.).

Evans, J. R., & Mathur, A. (2005). The value of online surveys. *The Emerald Resarch Register, 15*(2).

Fairlie, R. W. (2004). The effects of home computers on school enrollment. *Economics of Education Review, 24*(5), 533-547.

Federal Communication Commission. (2010). *Connecting America: The National Broadband Plan*. Washington DC.

Federal Comunication Commission. (2011). *Seventh Broadband Progress Report and Order on Reconsideration*. Washington DC.

Fitzmaurice, M., & Coughlin, J. (2007). Teaching philosophy statements: A guide. In C. O. Farrell (Ed.), *Portfolio Practice in Ireland: A Handbook*. Dublin.

Fuchs, T., & Woessman, L. (2004). Computers and student learning: bivariate and multivariate evidence on the availability and use of computers at home and at school. *Brussels Economic Review, 47*(3-4), 359-386.

Fullan, M. (2007). *The new meaning of educational change*. New York: Teachers College.

Fulton, K., & Sibley, R. (2003). *Barriers to equity*. Boston: Allyn & Bacon.

Gall, M., Gall, J., & Borg, W. (2007). *Educational research: An introduction. (8th Ed.)*. White Plains: Longman Publishers USA.

Gardner, S. K. (2008). "What's too much and what's too little?": The process of becoming an independent researcher in doctoral education. *The Journal of Higher Education, 79*(3).

Gargani, J. (2012). Running hot and cold for mixed methods: Jargon, jongar, and code, from http://evalblog.com/2012/03/26/running-hot-and-cold-for-mixed-methods-jargon-jongar-and-code/

GCI. (2009). *Broadband Technology Opportunities Program Grant Application*. Washington DC.

Gravelle, P. B. (2003). Early evidence from the field, the Maine Learning Technology Initiative: Impact on the digital divide *Occasional Paper #2*: Center for Education Policy, Applied Research and Evaluation.

Greaves Group & Hayes Connection. (2006). America's digital schools: A five-year forecast - mobilizing the curriculum.

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *American Educational Research Journal, 11*(255).

Hacker, K. L., & Mason, S. M. (2003). Ethical gaps in studies of the digital divide. *Ethics and Information Technology, 5*, 99-115.

Hall, G., George, A., & Rutherford, W. (1977). Measuring stages of concern about the innovation: A manual for use fo the SoC questionnaire. Austin: Austin Research and Development Center for Teacher Education.

Hamilton, B. (2007). *It's elementary! Integrating technology in the primary grades.* Paper presented at the International Society for Technology in Education, Eugene, Oregon.

Hammond, L., Love, S., Baldwin, L., & Chen, S. (2008). Evaluating WebCT use in relation to students' attitude and performance. *International Journal of Information and Communication Technology Education, 4*(2).

Hansen, S., & VanFleet, J. (2003). A handbook on issues and options for traditional knowledge holders in protecting their intellectual property and maintaining diversity. Washington DC.

Hanson, W., Creswell, J., Plano-Clark, V., & Petska, K. (2005). Mixed methods research designs in counseling psychology. *Journal of Counseling Psychology, 52*(2), 224-234.

Harden, R., & Crosby, J. (2000). The good teacher is more than a lecturer - the twelve roles of the teacher. *AMEE Education Guide, 22*(4), 224-247.

Hargittai, E. (2003). *New Economy Handbook*. San Diego: Academic Press.

Hew, K. F., & Brush, T. (2006). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Education Technology Research and Development, 55*, 223-252.

Hirshberg, D., & Hill, A. (2006). Turnover Among Alaska's Teachers: How many leave their jobs? In I. o. S. a. E. Research (Ed.), (Vol. 66). Anchoreage: University of Alaska Anchorage.

Holcomb, L. B., Castek, J. M., & Johnson, P. R. (2007). Unlocking the potential of K-12 classroom websites to enhance learning. *New England Reading Association Journal, 43*(1), 36.

Horrigan, J. B. (2010). Federal Communications Commission: Broadband adoption and use in America.

Hu, W. (2007). Seeing No Progress, Some Schools Drop Laptops, *The New York Times*.

Johnson, B. R., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14-26.

Jonassen, D., & Reeves, T. C. (1996). *Learning with teachnology: Using computers as cognitive tools*: New York: Macmillan.

Judge, S., Puckett, K., & Bell, S. M. (2006). Closing the digital divide: Update from the early childhood longitudinal study. *The Journal of Educational Research, 100*(1), 52.

Kane, M., Beals, C., Valeau, E. J., & Johnson, M. J. (2004). Fostering success among traditionally underrepresented student groups: Hartnell college's approach to implementation of the math, engineering, and science achievement program. *Community College Journal of Research and Practice, 28*, 17-26.

Kaplan, A. M., & Michael, H. (2011). The early bird catches the news: Nine things you should know about micro-blogging. *Business Horizons, 54*(2).

Kawagley, A., Norris-Tull, D., Norris-Tull, R., (1998). (The indigenous worldview of Yupiaq culture: It's scientific nature and relevance to the practice and teaching of science). Journal of Research in Science Teaching. *35, 2*(133-144).

Keefe, J. (1979). *Learning style: An overview Student learning styles: diagnosing prescribing programs*. Paper presented at the National Association of Secondary School Principals, Reston, WA.

Kulik, J. A. (2003). Effects of using instructional technology in elementary and secondary schools: What controlled evaluation studies say. In S. International (Ed.).

Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Thousand Oaks: Sage Publications, Inc.

Kvasny, L. (2002). *Problematizing the digtial divide: Cultural and social reproduction in a community technology iniative.* Doctor of Philosophy, Georgia State University, Athens.

Kvasny, L., & Keil, M. (2006). The challenges of redressing the digital divide: A tale of two cities. *Information Systems, 16*, 23-53.

Lather, P. (1999). To be of use: the work of reviewing. *Review of Educational Research, 99*(1), 2-7.

Ledoux, L. (2012). *Polishing the mirror: A multiple methods study of the technology mediated relationship between instruction and learning in Alaska's 1:1 digital high school classrooms.* Unpublished Dissertation, University of Alaska Fairbanks.

LeFever, I. (2012). Social bookmarking in plain English, from http://www.commoncraft.com/video/social-bookmarking

Lemke, C. (2009). Innovation through technology.

Lemke, C., Coughlin, E., Garcia, L., Reifsneider, D., & Baas, J. (2009). Leadership for web 2.0 education: Promise and reality. Culver City: Metiri Group.

Lemke, C., Coughlin, E., & Reifsneider, D. (2009). Technology in schools: What the research says, a 2009 update: Cisco Systems, Inc.

Lemke, C., & Martin, C. (2003). One-to-one computing in Maine: A State profile. Culver City: Metiri Group.

Libby, D. (1999). RSS 0.91, from http://web.archive.org/web/20001204093600

Lowther, D., Morrison, G., & Ross, S. (2003). When each one has one: The influence on teaching strategies and student achievement of using laptops in the classroom. *Education Technology Research and Development, 3*, 23-44.

Lowther, D., Ross, S., & Morrison, G. (2001). *Evaluation of a laptop program: Successes and recommendations*. Paper presented at the National Education Computing Conference "Building on the Future", Chicago, IL.

Lowther, D., Strahl, J. D., Zoblotsky, T., & Huang, Y. (2008). Florida's Enhancing Education Through Technology (EETT) Leveraging Laptops: Effective Models for Enhancing Student Achievement. Memphis: Center for Research in Educational Policy.

Marzano, R., Waters, T., & McNulty, B. (2005). *School leadership that works: From leadership to results*. Paper presented at the Association for Supervision and Curriculum Development, Alexandria, VA.

McCauley, S. (2008). *The Quality Schools Model of education reform: A description of staff focus beliefs and practices using Baldridge in education criteria.* PhD, University of Alaska Fairbanks, Fairbanks.

Mead, M. (1937). *Cooperation and competition among primitive peoples*. New York: McGraw Hill.

Metiri Group. (2006). 1 to 1 learning: A review and analysis In A. C. Inc. (Ed.).

Metiri Group, & The University of Calgary. (2009). Emerge one-to-one laptop learning initiative: Year one report. In S. T. B.-A. Education (Ed.), (pp. 1-35). Edmonton, AB: The Metiri Group and The University of Calgary.

Miller, W., & Irby, B. (1999). An inquiry into the exigency of a beginning doctoral cohort in education leadership. *College Student Journal, 33*(3).

Morse, J. M. (2003). *Handbook of mixed methods in social & behavioral research.* Thousand Oaks: Sage Publications, Inc.

Moustakas, C. (1994). *Phenomenological research methods.* Thousand Oaks, CA: Sage.

Muijs, D. (2010). *Doing quantitative research in education with SPSS.* Thousand Oaks: Sage Publications, Inc.

Murdock, G., Harmann, P., & Gray, P. (1992). *Contextualizing Home Computing Resources and Practices.* New York: Routledge.

National Center for Education Statistics. (2004). Differences in home, school, and library use of the internet by at-risk students: Library Research Service.

National Commission on Excellence in Education. (1983). *A nation at risk.* Washington DC.

NCES. (2008). *Education Technology in U.S. Public Schools: Fall 2008.* Washington DC.

Norris, C., Sullivan, T., Poirot, J., & Soloway, E. (2003). No access, no use, no impact: Snapshot surveys of educational technology in K-12. *Journal of Research on Technology in Education, 36*(1), 15.

NTIA. (2000). *Falling through the net: Toward digital inclusion - a report on Americans' access to technology tools.* Washington DC.

NTIA. (2010). *Digital Nation: 21st century America's progress toward universal broadband internet access.* Washington DC.

NTIA. (2010). *BroadbandUSA: Connecting America's Communities.* Washington DC.

Ohler, J. (2009). An inside look at AASB's consortium for digital learning 1-to-1 initiative: CDL mid-project summary report: Association of Alaska School Boards.

Ohler, J. (2011). An inside look at AASB's consortium for digital learning 1-to-1 initiative. Juneau: Association of Alaska School Boards.

Oppenheimer, T. (1997). The computer delusion. *The Atlantic Monthly*, 45-62.

Parker, C. E. (2006). *Learner Identity, Learning Technologies, and Learner Diversity: A Review of Literature.*

Partnership for 21st Century Skills. (2010). 21st century readiness for every student: A policymaker's guide: Partnership for 21st Century Skills.

Peck, K., Clausen, R., Vilberg, J., Meidl, C., & Murray, O. (2008). Classrooms for the Future Year 2 Evaluation.

Penuel, W. R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*(3), 329-348.

Penuel, W. R., Kim, D. Y., Michalchik, V., Lewis, S., Means, B., Murphy, R. (2002). Using technology to enhance connections between home and school: SRI International.

Puentedura, R. R. (2006). Transformation, technology, and education: SAMR technology adoption cycle Retrieved January 10, 2010, from http://hippasus.com/resources/tte/

Rea, L. M., & Parker, R. (2005). *Designing & Conducting Survey Research, A Comprehensive Guide*. San Francisco: Jossey - Bass.

Reeves, T. C. (2007). A Model of the Effective Dimensions of Interactive Learning on the World Wide Web. Athens: University of Georgia.

Robinson, J., DiMaggio, P., & Hargittai, E. (2003). New Social Survey Perspectives on the Digital Divide. *IT and Society, 1*(5), 1-22.

Robinson, M. G. (2007). *Digital divide: The impact of home information and communication technology access on K-12 learning opportunities.* Doctor of Philosophy, University of Alabama, Tuscaloosa.

Rockman, S. (2003). Learning from laptops. *Threshold.*

Rogers, E. M. (1986). *Communication Technology*. New York: Free Press.

Rogers, E. M. (2003). *Diffusion of Innovations*. New York: The Free Press.

Rosen, Y. (2011). *Intertwining digital content and one-to-one laptop environment in teaching and learning: Lessons from Time To Know program*. Paper presented at the International Society for Technology in Education, Philadelphia.

Ross, S., Lowther, D., & Alberg, M. (2006). The school observation model. Memphis: The University of Memphis: Center for Research in Educational Policy.

Ross, S., Lowther, D., Wilson-Relyea, B., Wang, W., & Morrison, G. (2003). Anytime, Anywhere Learning: Final Evaluation Report of the Laptop Program: Year 3: University of Memphis.

Ross, S., & Strahl, J. D. (2005). Evaluation of Michigan's Freedom to Learn Program: Center for Research in Educational Policy.

Sandoval, W. A., & Bell, P. (2004). Design-based research methods for studying learning in context: Introduction. *Educational Psychologist, 39*(4), 199-201.

Schmitt, J., & Wadsworth, J. (2004). Is There an Impact of Household Computer Ownership on Children's Educational Attainment in Britain? *Discussion Paper No. 625*: Centre for Economic Performance

Schofield, J., & Davidson, A. (2001). *Bringing the internet to school: Lessons from an urban district.* San Francisco: Jossey-Bass.

Schwartzbeck, T. (2012). The digital learning imperative: How technology and teaching meet today's education challenges

Shapley, K. S., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2010). Evaluating the implementation and fidelity of technology immersion and its relationship with student achievement. *Journal of Technology, Learning, and Assessment, 9*(4), 69.

Shapley, K. S., Sheehan, D., Sturges, K., Caranikas-Walker, F., Huntsberger, B., & Maloney, C. (2006). Evaluation of the Texas Technology Immersion Pilot: First-Year Results: Texas Center for Educational Research.

Silvernail, D., & Buffington, P. J. (2009). Improving Mathematics Performance Using Laptop Technology: the Importance of Professional Development for Success: Maine Education Policy Research Institute.

Silvernail, D., & Lane, D. (2004). The Impact of Maine's One-to-One Laptop Program on Middle School Teachers and Students: Maine Education Policy Research Institute.

Silvernail, D., Pinkham, C., Wintle, S., Walker, L., & Bartlett, C. (2011). A Middle School One-to-One Laptop Program: The Maine Experience: Maine Education Policy Research Institute.

Slamecka, B. (2011). *A Cross-Case Study of the Impact of OrganizationalChangee through the Diffusion of Classrooms for the Future Initiative.* Indiana University of Pennsylvania.

Sobel, D. (2004). *Place-based education: Connecting classrooms and communities.* Great Barrington, Maryland: The Orion Society.

Sparrow, L., Sparrow, H., & Swan, P. (2000). *Student centered learning: Is it possible?* . Paper presented at the 9th Annual Teaching Learning Forum, Perth, Australia.

Standley, M. (2012). *Kids Getting Away with Learning.* Unpublished Dissertation. University of Alaska Fairbanks. Fairbanks, Alaska.

Strauss, A. (1998). *Basics of qualitative research: techniques and procedures for developing grounded theory.* Newbury Park, CA: Sage.

Tolbert, C. J., & Mossberger, K. (2006). New Inequality Frontier: Broadband Internet Access. In E. P. Institute (Ed.), *EPI Working Paper No. 275.*

Tsikalas, K., & Gross, E. (2002). *Home computer use among low-income, minority urban adolescents: Fulfillment of basic needs and Impact on Personal and Academic Development.* Paper presented at the American Educational Research Association, New Orleans, LA.

U.S. Census Bureau. (2010). Profile America: Facts for Features Back to School: 2010-2011, from http://www.census.gov/newsroom/releases/archives/facts_for_features_special_editions/cb10-ff14.html

U.S. Census Bureau. (2011). Profile America: Facts for Features Back to School: 2010-2011, from http://www.census.gov/newsroom/releases/archives/facts_for_features_special_editions/cb10-ff14.html

U.S. Department of Commerce. (1995). Falling through the net. A survey of the "have nots" in rural and urban America: National Telecommunications and Information Administration (NTIA).

Universal Services Administrative Company. (2011). Universal Service Administrative Company Retrieved 11/28/2011, from http://www.usac.org/sl/about/overview-program.aspx

Van Hover, S. D., Berson, M. J., Bolick, C. M., & Swan, K. O. (2006). Implications of ubiquitous computing for the social studies curriculum. *Contemporary Issues in Technology and Teacher Education, 6*(2), 275-283.

Vigdor, J. L., & Ladd, H. F. (2010). Scaling the Digital Divide: Home Computer Technology and Student Achievement. Durham: National Center for Analysis of Longitudinal Data in Education Research.

Wagner, J. (2008). Classrooms for the Future: A Special Performance Audit. Harrisburg: Pennsylvania Department of the Auditor General.

Wallace, R. M. (2004). A framework for understanding teaching with the internet. *American Educational Research Journal, 41*(2), 447.

Warschauer, M. (2003a). *Technology and Equity: A Comparative Study*. Paper presented at the American Educational Research Association, Chicago, Illinois.

Warschauer, M. (2003b). Technology and Social Inclusion: Rethinking the Digital Divide M. I. o. Techology (Ed.)

Warschauer, M. (2006). *Laptops and literacy: Learning in the wireless classroom.* New York: Teachers College Press.

Warschauer, M. (2008). Laptops and Literacy: A Multi-Site Case Study. *An International Journal, 3*, 52-57.

Warschauer, M., Knobel, M., & Stone, L. (2002). Technology and equity in schooling: Deconstructing the digital divide. *Educational Policy, 18*(4), 562-588.

Warschauer, M., Knobel, M., & Stone, L. (2004). Technology and Equity in Schooling: Deconstructing the Digital Divide. *Educational Policy, 18*(4), 562-588.

Warschauer, M., & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education, 34*(179).

Webb, E. J., Campbell, D. T., Schwartz, R. D., & Sechrest, L. (1966). *Unobtrusive Measures: Nonreactive Measures in the Social Sciences*. Chicago: Rand McNally.

Wesson, L. H., Holman, S. O., Holman, D., & Cox, D. (1996). *Cohesion or Collusion: Impact of a Cohort Structure on Educational Leadership Doctoral Students.* Paper presented at the American Educational Research Association, Arkansas.

Whicker, R. (2012). *Framing Complexity: Teachers and Students Use of Technology in Alaska One to One Laptop Learning Environments.* Unpublished Dissertation, University of Alaska Fairbanks, Fairbanks.

Wilhelm, A. G. (2003). Civic Participation and Technology Inequality: The "Killer Application" in Education. In D. Anderson & M. Cornfield (Eds.), *The Civic Web* (pp. 113-128). New York: Rowan & Littlefield.

Zickuher, K. (2010). Generations 2010 *Generations 2010*: Pew Internet.

Zucker, A. (2004). Developing a research agenda for ubiquitous computing in schools. *Journal for Educational Computing Research.*

Zucker, A. (2005). A Study of One-to-One Computer Use in Mathematics and Science Instruction at the Secondary Level in Henrico County Public Schools. In S. International (Ed.).

Zucker, A., & Hug, S. (2007). A Study of the 1:1 Laptop Program at the Denver School of Science & Technology. Denver: Denver School of Science & Technology.

Zucker, A., & McGhee, R. (2005). A study of one-to-one computer use in mathematics and science instruction at the secondary level in Henrico County Public Schools. Washington DC: SRI International.

Appendix A: Cohort Model

This dissertation is one of four inter-related studies focusing on the digital landscape in one-to-one laptop environments within classrooms in Alaska's public high schools. Each of the four doctoral students analyzed aspects of teaching and learning in one-to-one computing environments that exist within public schools in Alaska, each approaching their own individual study from their individual perspectives. The cohort model provided a professional atmosphere for social learning (Wesson, Holman, Holman, & Cox, 1996). Wesson et al., (1996) continue to write about the formal and informal social processing in a cohort promoting a learning environment rich in collaboration and cooperation. This has been very true for the model offered to the four cohort members over a three-year time-span.

The cohort structure and agreements within it helped to build common vision of the combined research effort and manage differences of opinion. Recommendations for a good working structure are to: (a) organize an cohort with similar levels of experience; (b) attend to the personal dynamics of the group; (c) create a culture where difference of opinion is respected, valued, and open; (d) establishment of the expectation that feedback will be provided; and (e) opportunities are present for informal exchange (Creamer, 2004). In addition, the knowledge of and access to the network of associates each cohort member brought to the table enabled each individual to benefit from a much larger range of logistical support in the research of individual studies.

Positive cohort experiences, specifically in preparing scholarly practitioner leaders built on each researcher's professional experiences coupled with a collaborative structure, have shown to produce higher rates of completion (Barnette & Muth, 2008). The four members making up the technology cohort exemplified this statement. There were many times the cohort did not give-up because of the consistent support of each of the members. In addition, the cohort shared common coursework, collected research data through common survey instruments using the same program population, as well as shared common committee members.

Having similarities in background and experience is beneficial for a cohort (Dorn, Papalewis, & Brown, 1995). All members of our cohort had backgrounds in Alaska education, having taught many years in Alaska individually and were recognized as influencers in educational technology and Alaska education in general. Each of the four cohort members came to the research topic with previous experience and expertise, at a school, district and state levels for one-to-one laptop implementations. Each has experience working in school districts.

Larry LeDoux is the former Commissioner for the Alaska Department of Education and Early Development. During his 30 years in the Kodiak Island Borough School District, he has served as superintendent, principal, teacher, and technology director. Larry is currently working as a private education consultant.

Pam Lloyd served fifteen years in the Anchorage School District as both an administrator and a classroom-teacher. She held the position of K-12 Instructional Technology Coordinator for six years. Pam has held numerous board positions including President of the Alaska Society for Technology in Education, and President of Cook Inlet Literacy Council. She currently serves as President of the Alaska Academic Decathlon and is on the U.S. Academic Decathlon board of directors. She currently works for General Communications, Incorporated (GCI). GCI is an Alaskan-based telecommunications company providing voice, video, and data communication services to residential, commercial, and government customers. Pam currently is the Director of GCI SchoolAccess, a division within GCI, providing internet access and distance learning services for schools across Alaska, New Mexico, and Montana.

Mark Standley has served in the capacity of teacher, principal and assistant superintendent across several districts in Alaska, including the Anchorage School District. He was formerly co-chair of the State's Technology Standards group (1990-1991) and is President-elect of the Alaska Society for Technology in Education. He currently is the CEO for a non-profit, Education 4 Leadership, focused on one-to-one implementation and supervises/teaches education research to pre-service principals for the University of Alaska Southeast (UAS) Education Leadership Program.

Robert Whicker, a former teacher, principal, and superintendent, ended his K-12 career in the Denali Borough School District, one of Alaska's first one-to-one laptop implementation districts. His journey led him to work for Apple, Inc. as a Development Executive, working with school districts in their implementation of one-to-one laptop programs across the western U.S. He currently is the Director for the Association of Alaska School Boards, Consortium for Digital Learning program, and serves on the Alaska Broadband Task Force.

Together, the members of this cohort have a plethora of knowledge, experience, and expertise in the field of technology and education. They have all known and worked with each other over the years in these various capacities, at the national, state and district levels.

Cohort groups in research bring a larger network of resources to benefit the group (Miller & Irby, 1999). Time and time again, the vast amount of experience of the Tech Cohort benefitted not only the group in its organization but each individual. The differences in perspective of cohort members enable each individual to test their theories against each other (Creamer, 2004). Just as the previous University of Alaska Fairbanks (UAF) cohort, (Atwater, 2008; Cope, 2008; Crumley, 2008; McCauley, 2008) this cohort shared the importance of the commitment to a common goal, making the research process a true community of practice through discourse, mixed methods and models. The cohort shared classes and met outside of class regularly to discuss the overarching topic of one-to-one laptops in the digital landscape of Alaska.

Each member of the cohort looked through a unique lens sharing interest in an overarching topic to research teaching and learning in the Alaskan digital landscape. The four cohort members and their dissertation topics were:

Larry LeDoux's research is a mixed methods study, titled, "Polishing the mirror: a multiple methods study that examined the relationship between teaching style and the application of digital learning technologies in Alaska's one-to-one laptop programs". Larry researched the outcome of this relationship as a key determinant in the success of strategies to create learner environments that are consistent with both Alaska Native and 21st century practices and outcomes.

Pamela Lloyd's research is a mixed method study, titled, "Digital dead-ends along Alaska's information highway: home broadband access for teachers and students in Alaska's high school one-to-one laptop programs". Pamela researched the Levels of Adoption (LoA) among three categories of bandwidth availability in the community for teachers and students.

Mark Standley's research is a qualitative study, titled, "Kids getting away with learning: student perceptions of a one-to-one laptop program". Mark listened to students' views of learning in and outside of school structures by conducting focus groups with high school students in five schools.

Robert Whicker's research is a mixed study, titled "Framing complexity: teachers and students use of technology in Alaska one-to-one laptop high schools". Robert researched the perceptions of teachers and students in the implementation, levels of use, and concerns identified by teachers in Alaska's high school one-to-one laptop program

The relationship between each cohort members' research topic and questions related to the overarching theme is shown in Figure 21 (Whicker, 2012).

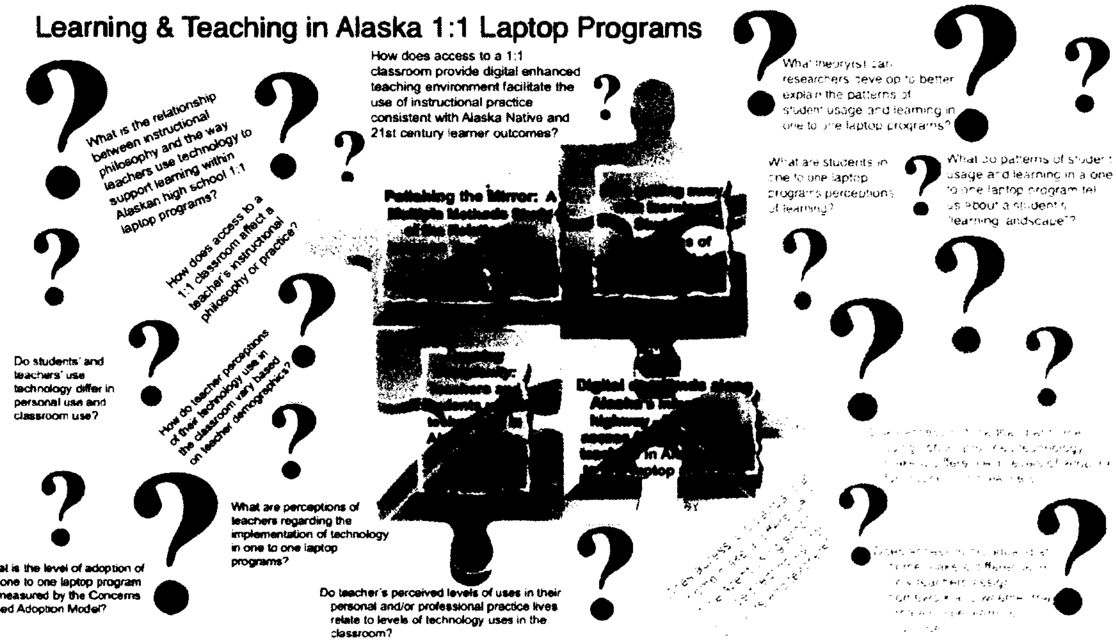


Figure 21. Cohort topic relationships puzzle.

A 215-item questionnaire for teachers, with nine open-ended questions and a 100-item questionnaire, with three open-ended questions for students, were collaboratively created by three of the four cohort members. The cohort shared in the role for dissemination of the surveys to districts identified as having predefined criteria. This effort led to response rates of 40% for teachers (n=94), and 43% for students (n=725). This shared effort led to higher response rates and a much larger dataset then if the cohort had taken on the role of data gathering, individually. The fourth cohort member created questions for qualitative focus groups using input from the three other members to gather student perceptions related to questions on the online survey.

The cohort also coordinated a pilot study in January 2011 in a remote village in Northwest Alaska to test out the online survey and focus group instruments. This required part of the cohort to be at the school and part to be online to test questions, timing, and technology involved with our research gathering instruments. This team effort led to better online surveys and focus group questions, some contributed by each member of the cohort. This shared field-testing and pilot study gave the entire team more confidence and better tools for conducting the research.

The cohort modeled many of the practices and roles to the cohort previous, in that this cohort developed a community of practice and a vision for shared leadership (Atwater, 2008; Cope, 2008; Crumley, 2008; McCauley, 2008). This cohort also functioned as a "knowledge mini-market" (Cope, p. xxiv) as they reviewed literature, created meaning and shared knowledge (Cope, 2008).

For many doctoral students, the individualized, independent structure of a traditional doctoral program can lead to frustration and failure. This frustration has led 40% to 70% of the doctoral student population down the path of dropping out and feelings of failure (Gardner, 2008). For many traditional doctoral students, the transition from "consumers of knowledge to creators of knowledge" (Gardner, p. 12) causes much isolation in the doctoral process (Gardner, 2008). The cohort model experience did not reflect feelings of isolation or frustration, but rather a feeling of belonging to a group with a common purpose and commitment to four members, sometimes driving simultaneously, and sometimes one at a time.

Researchers shared the idea that cohort models take on a collective personality. The cohort definitely came together with individual personality and voice. While there was not always agreement, there was support for each other throughout the process. The cohort shared a collegiality and trust to question for understanding that pushed each member into the next step of the process in becoming a more effective researcher. The benefits experienced by each cohort member in this model supported the research findings, and provided a successful learning community for each member of the cohort. The main reason for doctoral students in an Illinois university completing their programs was the support and encouragement of their cohort members (Brien, 1992).This was most certainly true for this cohort. There is no doubt that without the continued uplifting nature of our cohort members toward each other, we might be writing still. Due to the demands of the professional careers and the pressure of the demands of our doctoral programs endured by each one of our cohort members, support and understanding of mutual challenges between cohort members was crucial.

The structure of each cohort takes on its own unique identity (Dorn & Papalewis, 1997). The identity of the cohort came to be one where, as we progressed through phases of the dissertation process, individuals interacted with each other in roles of cheerleader, "got your back" voice of reason, devil's advocate, philosopher, connector, and practitioner. Through spirited discussions between cohort members, ideas were vetted and led research into areas supportive to each individual's research.

The cohort met regularly over a three-year period. Weekly Monday night classes common to all members, overlapping working schedules during educational conferences and in airport boardrooms, and regularly scheduled teleconferences reinforced the team support of each individual. The development of a team structure where each member was valued provided informal support and the encouragement needed to persist in our research. The experiences of this cohort support the findings of the researchers cited above that the benefits of the cohort model are indeed tangible and worth replicating in other doctoral programs.

Appendix B: 2010-2011 Last Mile Connectivity by Service Area

2010-2011 Last Mile Connetivity by Service Area

Community	School District	Community Population in 2010	Middle Mile Delivery	Last Mile Service Provider	Technology Platform	Service Tier	Advertised Residential Offering	
							Download Speed (Upload)	Monthly Price
Akutan	AEBSD	1027	Satellite	GCI	WISP	Entry Level Plan	up to 256K/56K	$50.00
False Pass	AEBSD	35	Satellite	GCI	WISP	Entry Level Plan	up to 256K/56K	$49.99
King Cove	AEBSD	938	Satellite	TelAlaska	DSL	Entry Level Plan	256 kbps	$45.00
				GCI	WISP	Entry Level Plan	up to 256K/56K	$49.99
Nelson Lagoon	AEBSD	52	Satellite	GCI	WISP	Entry Level Plan	up to 256K/56K	$49.99
Sand Point	AEBSD	976	Satellite	TelAlaska	DSL	Entry Level Plan	256 Kbps	$45.00
Cold Bay	AEBSD	108	Satellite	TelAlaska	DSL	Entry Level Plan	256 Kbps	$45.00
				GCI	WISP	Entry Level Plan	up to 256K/56K	$49.99
Naknek	BBBSD	544	Satellite	Bristol Bay Telephone	Dial Up	Entry Level Plan	56K Dialup	$25-$40
					Wireless	Wireless	up to 256k/56k	$51-$101
Cordova	Cordova	2239	Satellite	GCI	Cable Modem	Regional Xtreme 1.0	1 Mbps/512 Kbps	$59.99
						Regional Xtreme 2.0	2 Mbps/512 kbps	$69.99
						Regional Xtreme 3.0	3 Mbps/768 Kbps	$89.99
						Regional Xtreme 4.0	4 Mbps/1 Mbps	$119.99
Klawock	Klawock	755	same as Haines					
Aniak	Kuspuk	501	Satellite	BushTel				
				GCI	WISP	Entry Level Plan	up to 256K/56K	$50.00
				AT&T Alascom	DSL	Entry Level Plan	128 Kbps	$35.00
						High Speed Plan	384 Kbps	$45.00
						Other Plans (e.g. Mid-Tier)	256 Kbps	$55.00
Chuathbaluk	Kuspuk	118	Satellite	Hughes Net	Starband			
Crooked Creek	Kuspuk	105	Satellite	Hughes Net	Starband			
Kalskag	Kuspuk	190	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Sleetmute	Kuspuk	86	Satellite	BushTel				
				GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Juneau	Juneau	31275	Fiber	GCI	Cable Modem	Xtreme 3.0	3 Mbps/512 Kbps	$49.99
						Xtreme 10.0	10 Mbps/1 Mbps	$69.99
						Xtreme 15.0	15 Mbps/1 Mbps	$79.99
						Xtreme 18.0	18 Mbps/1.5 Mbps	$119.99
						Xtreme 22.0	22 Mbps/2 Mbsp	$169.99
Haines	Haines	2508	Microwave	APT	DLS	Broadband Packages	64k	$29.95
							256k	$49.95
							512k	$59.95
							1 Mb	$79.95
							4 Mb	$99.95
							8 Mb	$159.95
			Satellite	Hughes Net			See Below	see below
			Satellite	Starband			See Below	see below
Kongiganak	LKSD	439	Satellite	UUI/Unicom	DSL		Up to 256k/64k	$49.95
Kwethluk	LKSD	721	Satellite	UUI/Unicom	Dial Up	Entry Level Plan	Dial up	$19.95
Napaskiak	LKSD	405	Satellite	UUI/Unicom	Dial Up		Dial up	$19.95
Nunapitchuk	LKSD	496	Satellite	UUI/Unicom	Dial Up		Dial up	$19.95
Napakiak	LKSD	354	Satellite	UUI/Unicom	Dial Up		Dial up	$19.95
Toksook Bay	LKSD	590	Satellite	UUI/Unicom	DSL		Up to 256k/64k	$49.95
				GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99

Kasigluk	LKSD	569	Satellite	UUI/Unicom	Dial Up		Dial up	$19.95
Kwigillingok	LKSD	321	Satellite	UUI/Unicom	DSL		Up to 256k/64k	$49.95
				GCI	WISP		Up to 256k/64k	$49.99
Anaktuvuk Pass	NSBSD	324	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Atqasuk	NSBSD	233	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$50.00
Barrow	NSBSD	4212	Satellite	GCI	Cable Modem	HyperNet Silver	512 kbps/128Kbp	$49.99
						HyperNet Silver Plus	1 Mbps/256kbps	$59.99
						HyperNet Gold	1.5 Mbps/384 Kb	$99.99
						HyperNet Platinum	2 Mbps/512 Kbps	$149.99
Katkovik	NSBSD	239	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Nuiqsut	NSBSD	402	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Point Hope	NSBSD	674	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Point Lay	NSBSD	189	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Wainwright	NSBSD	556	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Buckland	NWABSD	416	Satellite	GCI	WISP	Entry Level Plan	Up to 256k/64k	$49.99
Kivalina	NWABSD	374	Satellite	OTZ				
Selawick	NWABSD	829	Satellite	OTZ				
Shungnak	NWABSD	262	Satellite	OTZ				
Petersburg	Petersburg	2948	Fiber	GCI	Cable Modem	Xtreme 3.0	3 Mbps/512 Kbps	$49.99
						Xtreme 10.0	10 Mbps/1 Mbps	$69.99
						Xtreme 15.0	15 Mbps/1 Mbps	$79.99
						Xtreme 18.0	18 Mbps/1.5 Mbps	$119.99
						Xtreme 22.0	22 Mbps/2 Mbsp	$169.99
New Stuyahok	SWRSD	510	Satellite	Hughes Net	Satellite Dish	See Below	See Below	
Koliganek	SWRSD		Satellite					
Wrangell	Wrangell	2369	Fiber	GCI	Cable Modem	Xtreme 3.0	3 Mbps/512 Kbps	$49.99
						Xtreme 10.0	10 Mbps/1 Mbps	$69.99
						Xtreme 15.0	15 Mbps/1 Mbps	$79.99
						Xtreme 18.0	18 Mbps/1.5 Mbps	$119.99
						Xtreme 22.0	22 Mbps/2 Mbsp	$169.99

Appendix C: Cohort Glossary of Terms

Aboriginal: An adjective that refers to people originating from a specific area or place.

Analytic tools: Devices and techniques used by analysts to facilitate coding process (Charmaz, 2006; Strauss, 1998, p. 87).

Axial coding: The process of relating categories to their subcategories, termed "axial" because the coding occurs around the axis of a category, linking categories at the level of properties and dimensions (Strauss, 1998, p. 123).

Bandwidth Speed: The measure of available or consumed data communication resources expressed in bit/second or multiple bits/second as in kilobits per second or megabits per second. Bandwidth speed is also known as the throughput of the pipe in the data transmission.

Blog: A combination of the words web log where an author makes dated entries on a discussion or information site published to the World Wide Web (Blood, 2000).

Broadband: Refers to a telecommunication signal or device of greater bandwidth and is measured in speeds. The FCC has defined broadband speeds as 786 Kbps Download to the customer by 200 Kbps upload to the internet (Federal Communication Commission, 2010).

Categories: Concepts that stand for phenomena (Strauss, 1998, p. 101).

Classroom Use of Technology: The use of technology in the classroom with students in learning activities.

Coding: The analytic processes through which data are fractured, conceptualized, and integrated to form theory (Strauss, 1998, p. 3).

Concepts: The building blocks of theory (Strauss, 1998, p. 101).

Concurrent Embedded Design: A mixed method design where the priority between quantitative and qualitative data "is usually unequal and given to one of the two forms of data—either to the quantitative or qualitative data. The nested, or embedded, forms of data are, in these designs, usually given less priority" (Hanson, Creswell, Plano-Clark, & Petska, 2005, p. 229)

Culture: "The forms of traditional behavior which are characteristics of a given society, or of a group of societies, or of a certain race, or of a certain area, or of a certain period of time" (Mead, 1937, p. 17).

Culture-Based Education: An education process that uses "the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum (Sobel, 2004, p. 7).

Digital Divide: Refers to any inequalities between groups, broadly construed, in terms of access to, use of, or knowledge of information and communication technologies (U.S. Department of Commerce, 1995).

Digital Learning Technology: Digital applications that "encompasses a wide spectrum of tools and practice, including using online and formative assessment, increasing focus and quality of teaching resources and time, online content and courses, applications of technology in the classroom and school building, adaptive software for students with special needs, learning platforms, participating in professional communities of practice, providing access to high level and challenging content and instruction, and many other advancements that technology provides to teaching and learning" (Schwartzbeck, 2012, p. 1).

First Order Change: "Incremental change that fine-tunes the system through a series of small steps that do not depart radically from the past" (Marzano, Waters, & McNulty, 2005, p. 66).

Geostationary Satellites: These satellites are in a relatively fixed position in relation to the earth, allowing for ground antennas to be directed at the satellite.

Grounded Theory: "A method of conducting qualitative research that focuses on creating conceptual frameworks or theories through building inductive analysis from the data" (Charmaz, 2006, p. 187).

High Order Skills: Those skills necessary to "analyze, synthesize and apply evidence"... critical thinking, communication, problem-solving, collaboration and reasoning (Chun, 2010).

Internet Service Provider: An Internet Service Provider is a company that provides access to the internet.

Last-Mile Connectivity: The final connection from the internet provider hub to the end user location. The last-mile may be more than one-mile, especially in rural areas.

Learning Style: "A composite of the cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment" (Keefe, 1979).

Methodology: A way of thinking about and studying social reality (Strauss, 1998, p. 3).

Methods: A set of procedures and techniques for gathering and analyzing data (Strauss, 1998, p. 3).

Micro blogging: A broadcast medium of a blog which allows users to exchange small elements of content such as short sentences, individual images, or video links (Kaplan & Michael, 2011)

Middle-Mile Connectivity– In the broadband internet industry, the middle mile is the segment of telecommunications network linking a network operator's core network to the local network plant.

Mixed Method Design: A mixed-methods evaluation is one that "establishes in advance a design that explicitly lays out a thoughtful, strategic integration of qualitative and quantitative methods to accomplish a critical purpose that either qualitative or quantitative methods alone could not" (Gargani, 2012, p. 1).

One to one: The ratio of computing device per end user, a tool per learner and teacher.

One-to-One Classrooms: Technology rich classrooms that provide students with ubiquitous access to a laptop computers, teachers with necessary professional development and classrooms with sufficient access to the hardware, software, bandwidth and technical support to integrate technology into learning and instruction.

One to one laptop program definition for study: (a) students and teachers having access to laptops anytime, anywhere, in and out of school; (b) access to a wireless infrastructure; (c) the use of the laptops included in the curriculum as tools of learning; (d) a professional development model including technology integration in the learning process;

and (e) a policy of at-home use of a school issued laptop at some time during the program.

Open coding: The analytic process through which concepts are identified and their properties and dimensions are discovered in data (Strauss, 1998, p. 101).

Personal Use: The use of technology in personal life daily functions.

Phenomena: Central ideas in the data represented as concepts (Strauss, 1998, p. 101).

Photo sharing: The publishing or transfer of a user's digital photos online to share publicly or privately with individuals

Placed-Based Education: "Learning that is rooted in what is local—the unique history, environment, culture, economy, literature, and art of a particular place" (Allen & Wince-Smith, 2011, p. 23).

Professional Practice: The use of technology in the professional arena of teaching to include aspects of preparation, planning, administration, organization, assessment and professional development.

RSS - Really Simple Syndication: A family of web feed formats used to publish frequently updated works—such as blog entries, news headlines, audio, and video—in a standardized format enabling subscription (Libby, 1999).

Second Order Change: "Deep changes that alter the system in fundamental ways, offering a dramatic shift in direction and requiring new ways of thinking and acting" (Marzano, et al., 2005, p. 66).

Satellite Communications: Refers to a satellite stationed in space for the purpose of telecommunications. Communication satellites used for Alaska telecommunications use geostationary orbit satellites. Two-way satellite internet service involves both sending and receiving data from the remote Earth Station or Very Small Aperture Terminal (VSAT) usually located on premise of home or school, which relays the data via the terrestrial internet.

Satellite Latency: The delay between requesting data and the receipt of the response due to signal traveling 22,236 miles up and back from the satellite. Satellite latency equals 500-700 milliseconds from the end-user to the ISP, doubling for round-trip causing slow internet.

Social bookmarking: The use of a web site to mark resources found on the internet by URL by adding metadata tags and sharing those bookmarks with others (LeFever, 2012).

Student-Centric Instruction: An approach to learning that places an emphasis on "changes in students' learning and on what students do to achieve this rather than on what the teacher does" (Harden & Crosby, 2000, p. 338) by giving "students greater autonomy and control over choice of subject matter, learning methods and pace of study" (Sparrow, Sparrow, & Swan, 2000, p. 1). Used synonymously with constructivist instruction in study.

Teacher-Centric Instruction: Focuses "on the teacher as a transmitter of information, with information passing from the expert teacher to the novice" (Harden & Crosby, 2000, p. 338).

Teaching Philosophies: "Written statements of why teachers do what they do—their beliefs and theories about teaching, about students and about learning, all of which underpin what and how they teach" (Fitzmaurice & Coughlin, 2007, p. 3). Used synonymously with beliefs in study.

Teaching Style: Represent the practices and behaviors that a teacher uses to facilitate learning.

Technology Integration: The application technology "to introduce, reinforce, extend, enrich, assess, and remediate student mastery of curricular targets" (Hamilton, 2007, p. 20).

Terrestrial Communications: Refers to telecommunications that does not involve satellite transmission of any kind. Terrestrial connectivity is provided with data transmission on the earth using fiber, copper, Ethernet, and microwave. There is no latency with terrestrial connectivity.

Theory: A set of well-developed concepts related through statements of relationship, which together constitute an integrated framework that can be used to explain or predict phenomena (Strauss, 1998, p. 15).

Traditional Knowledge and Alaska Native Ways of Knowing: "Traditional knowledge (TK) is the information that people in a given community, based on experience and adaptation to a local culture and environment, have developed over time, and continue to develop" (Hansen & VanFleet, 2003, p. 1).

Twenty-First Century Skills: "The skills, knowledge and expertise students should master to succeed in work and life in the 21stcentury: core subjects and 21st century themes; learning and innovation skills; Information, media and technology skills and life and career skills" (Skills, 2011).

Video sharing: The publishing or transfer of a user's videos online to share publicly or privately with individuals.

Wiki: A website which allows its users to add, modify, or delete its content via a web browser using a simplified markup language or a rich-text editor (Encyclopedia Britannica, 2007).

Worldview: " A means of conceptualizing the principles and beliefs - including the epistemological and ontological underpinnings of those beliefs - which people have acquired to make sense of the world around them" (Kawagley, Norris-Tull, Norris-Tull, & 1998, The indigenous worldview of Yupiaq culture: It's scientific nature and relevance to the practice and teaching of science, p. 133).

Appendix D: Institutional Review Board

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UNIVERSITY OF ALASKA FAIRBANKS

Institutional Review Board

909 N Koyukuk Dr Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

December 21, 2010

To:	John Monahan, PhD Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[174779-2] Broadband Access in Rural Alaska: One-to-One Laptop Initiatives to Extend Learning Beyond the School Day

Thank you for submitting the New Project referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title:	Broadband Access in Rural Alaska: One-to-One Laptop Initiatives to Extend Learning Beyond the School Day
Received:	December 17, 2010
Expedited Category:	7
Action:	APPROVED
Effective Date:	December 21, 2010
Expiration Date:	December 21, 2011

This action is included on the January 27, 2011 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

Appendix E: Student Focus Groups

How long have you had your laptop?

During that time can you describe what you like most AND least about having a laptop?

What software(s) do you do use on your laptop when getting work done for your teacher or schoolwork?

What software(s) do you do on your laptop for your own enjoyment at school and home?

Can you describe a situation at school or home using your laptop where you felt you were learning?

What is the difference for you between the way you use your laptop for "work" and your laptop for "enjoyment"?

What part(s) of your entire laptop experience(s) would you consider "learning?"

How is your use of your school laptop different than how you use your home computer?

Is there anything else you'd like me to know about how you learn using your laptop?

Follow Up Questions from other cohort members:

1. If you have internet at home? How would you rate your bandwidth at home on a scale of 1-10? Why?

2. What is the best reason for having a 1:1 laptop program in your school?

3. How does a teacher's use of technology affect your motivation as a learner?